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AN
ATTACHED PAYLOAD OPERATIONS CENTER (APOC)
AT THE
GODDARD SPACE FLIGHT CENTER (GSFC)

Volume I

Prepared for:

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, MD 20771

Under Contract Number: NAS5-26962 Mod. Six (6)

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INTRODUCTION

The potential need for additional capability to support attached payload operations had been recognized based on the available capacity of the Johnson Space Center (JSC) Payload Operations Control Center (POCC) and the identified manifest. The JSC POCC was configured for single mission support and a dedicated three month period for supporting mission-unique configuration including integration of Electrical Ground Support Equipment (EGSE), testing, simulations and training for a full Spacelab mission was placed as a requirement. This limited the JSC POCC to the support of up to four full Spacelab missions per year, although the potential for supporting several other less complex missions using available POCC and other JSC capability was not precluded. In fact, utilization of the Mission Control Center (MCC) for the support of several non-Spacelab payloads has been proposed and is being implemented for specific missions.

The POCC requirements for supporting the Office of Space Science (OSS)-3 through -7 missions had previously been evaluated by the Engineering and Economics Research, Incorporated (EER). It was determined that support of these missions via the JSC POCC would not have been possible based on the traffic model. In particular, the need to support reflights of the payload within a period as short as three months could have necessitated maintaining the POCC configuration over this period. A

Remote Operations Center (ROC) concept had been developed to provide the required support, where this concept utilized an augmentation of existing Goddard Space Flight Center (GSFC) capability. This concept provided additional support capability to that provided by the JSC POCC, but was only suitable for the support of OSS-3 class payloads, since the capability to handle the potential complement of payloads and data rates of a more complex or full Spacelab mission was not provided. It should be noted that subsequent to the transfer of management responsibility for the OSS-3 through -7 missions to the Marshall Space Flight Center (MSFC) the missions were renamed ASTRO.

In the definition of the functional requirements for the Attached Payload Operations Center (APOC), the support requirements for the ASTRO payloads were an initial driver. However it was recognized that the GSFC had a potential need to support a range of attached payloads for which the Center was assigned management responsibility. In particular, these included the Solar Optical Telescope (SOT), OSS-2 (subsequently renamed the Shuttle High Energy Astrophysical Laboratory (SHEAL) payload), the Environmental Observation Mission (EOM)-A, and Starlab. The EOM-A missions have now been assigned to the MSFC. Starlab was originally proposed for configuration on up to two attached missions using the Spacelab with subsequent long duration flight on a space platform. Consideration was given to utilization of

Leasecraft to provide the platform support capability and current direction indicates that Leasecraft will now be utilized for initial Starlab missions.

The APOC concept was developed to provide support for ASTRO class payloads with consideration given to other payloads assigned GSFC mission management responsibility. However, the evaluation of the JSC POCC support capability assumed a larger emphasis based on concerns for its support capacity, development cost and high sustaining cost. In particular, the Spacelab Mission Integration Cost Assessment (SMICA) group was charged with the responsibility for evaluating the overall Spacelab support with particular emphasis on cost. The SMICA POCC working sub-group, a segment of this group, was given specific responsibility for evaluating the overall POCC support for attached payloads. In this context, the various options including utilization of the JSC POCC with possible expansion of its capability, augmentation of the JSC POCC capability with development of one or more remote facilities, or replacement of the JSC POCC with one or more facilities capable of meeting the manifest was considered. In this regard, remote facilities at the GSFC, MSFC and/or Kennedy Space Center (KSC) were all potential candidates, where the APOC represented the GSFC approach to satisfaction of this requirement. In the conduct of this evaluation, the JSC provided revised assessments of the JSC POCC capability including a redefinition of the dedicated support requirement as two months with a total capacity of six full

Spacelab missions per year. This revised capacity was utilized as a groundrule in the definition of APOC support requirements.

The APOC concept as developed has two potential configurations; an interim capability for supporting ASTRO class payloads and a final capability for supporting the complete attached payload manifest as defined by the National Aeronautics and Space Administration (NASA) Headquarters. The formulation of the concept with the associated functional requirements in this manner provides a significant benefit, since it allows the development of the APOC, if directed by NASA Headquarters, to be undertaken to meet either GSFC assigned payloads or overall attached payloads support requirements.

The APOC concept and associated functional requirements are presented in this volume. The information has been structured to provide a management oriented overview followed by detailed functional requirements and required schedule, cost and manpower resources needed for development and operation of the facility. More detailed information on data flows and operational scenarios for the APOC are contained in Volume II.

This volume contains the following major sections:

a. Background and Assumptions

A management overview of the APOC functional requirements and design are presented. This overview presents the rationale for developing the APOC concept and the assumptions utilized, and provides a summary of the concept complete with major functional areas and associated data flows. The attributes of this concept are formulized and the necessary resources needed for its development and operation presented.

b. POCC Capabilities.

The existing capability for supporting non-Spacelab payloads at the GSFC is defined. A summary of the requirements necessary to support operations from the APOC is provided followed by a detailed definition of the requirements for the APOC functions. Configurations for supporting both ASTRO and full Spacelab payloads are presented. The proposed utilization of the APOC to support the manifest and a loading analysis showing required capability is shown.

c. Software

An analysis showing the various functions to be supported, the total lines of code required, the code available and the changes needed for the implementation of the APOC are presented.

d. Hardware

The existing and new hardware required for the development of the APOC are presented. An evaluation of the hardware available from the JSC POCC, if a decision were made to breakdown this facility is shown, although utilization of JSC POCC hardware for the APOC implementation is not proposed.

e. Schedule

The APOC development schedule is presented based on the proposed phase-in of APOC capability to support the manifest.

f. Cost and Manpower.

Detailed cost and civil service manpower requirements are presented for APOC development and sustaining and mission-unique operation.

OVERVIEW

- BACKGROUND AND ASSUMPTIONS

  -- DEFINITION OF THE PROBLEM
  -- ASSUMPTIONS AND GROUND RULES
  -- PAYLOAD REQUIREMENTS CATEGORIZATION
  -- MANIFEST/TRAFFIC MODEL

- PROPOSED APOC SOLUTION

  -- APOC NETWORK/COMMUNICATIONS
  -- GSFC APOC SOLUTION
  -- APOC CONCEPT
  -- EXISTING EXPERIENCE/CAPABILITIES

- APOC ATTRIBUTES

  -- APOC ADVANTAGES/DISADVANTAGES
  -- APOC DEVELOPMENT RISKS

- SCHEDULE, COST AND MANPOWER SUMMARY

- APOC SUMMARY

DEFINITION OF THE PROBLEM

> **JSC PAYLOAD OPERATIONS CONTROL CENTER (POCC) HIGH SUSTAINING**
> **COST AND SUPPORT CAPACITY ISSUE, AND POCC EVOLUTIONARY TRENDS**

- JSC POCC DEVELOPMENT AND SUSTAINING COST CONCERNS

- TRAFFIC MODEL MANIFEST CONFLICTS IN JSC POCC INITIALLY PROJECTED BY 1984, NOW POSSIBLE AFTER 1987.

- JSC POCC CAPABILITY
  - -- INITIALLY
    - SINGLE MISSION SUPPORT
    - DEDICATED THREE MONTH REQUIREMENT
    - FOUR (4) MISSIONS PER YEAR IN SERIES
  - -- CURRENTLY
    - CAPABLE OF SUPPORTING FULL MANIFEST THROUGH 1987

- NEED TO CONSIDER ATTACHED PAYLOADS WITH BOTH NON-SPACELAB AND SPACELAB AVIONICS

- NEED TO DEFINE BEST POCC TRANSITION DATE BASED ON REQUIREMENTS, RISK AND COST ISSUES

- NEED TO CONSIDER FUTURE POCC SCENARIOS FOR REMOTE SCIENCE OPERATIONS AND TRANSITION TO SPACE STATION

ASSUMPTIONS AND GROUND RULES

- NASA HEADQUARTERS PROVIDED TRAFFIC MODEL

- JSC POCC CAN SUPPORT FULL MANIFEST THROUGH 1987 (ASSUMED NO MORE THAN 6 EVENLY SPACED FULL SPACELAB MISSIONS/YEAR)

- PAYLOADS/EXPERIMENTS SIMILAR TO THOSE CURRENTLY PLANNED AND IN DEFINITION PHASE

- BASIS FOR SUPPORT REQUIREMENTS ARE EXISTING JSC POCC CAPABILITY MODIFIED AS AGREED BY INTER-NASA CENTER MEETING AT MSFC ON JUNE 8 & 9, 1983, AND SUBSEQUENT NASA HEADQUARTERS DIRECTIVES

- PRESENT DISTRIBUTION OF MISSION OPERATIONS RESPONSIBILITIES

- MSOCC PLANNED UPGRADES WILL BE FOLLOWED

PAYLOAD REQUIREMENTS CATEGORIZATION

REQUIREMENT \ TYPE	MSFC PARTIAL	OTHER PARTIAL	FULL SPACELAB
AVIONICS	NON-SPACELAB	NON-SPACELAB	SPACELAB
PRIMARY GROUND OPERATION	SUPPORT	CONTROL/SUPPORT	CONTROL/SUPPORT
ORBITER OI DATA MONITOR	LIMITED	YES	YES
HIGH RATE DATA	NONE	DISTRIBUTION	DISTRIBUTION/PROCESSING
GROUND COMMANDING	NO	YES	YES
VOICE (MCC. A/G)	YES	YES	YES
A/G VIDEO MONITOR	YES	YES	YES
USER REQUIREMENTS (SPACE, CAPABILITY)	LIMITED	LIMITED	EXTENSIVE
DEDICATED USE OF PAYLOAD CONTROL ROOM (L-WEEKS)*	4	5	7
EGSE USER ROOM ACCESS (L-WEEKS)	NOT REQUIRED	6	8
EGSE SPACE (SQ. FT.)	0	500	1500-2600
DISASSEMBLY (WEEKS)	1	1	2
TRAINING (L-MONTHS)	2	6	12
MISSIONS	MSL-1 THRU -15 OAST-1&3 LFC-1	OAST-2 OSTA-3,5,7&9 CFMF-1,2&3 TSS-1 STEP-1,2&3 HH-1 THRU -9	SL-1,2,3,4,8&10 SL-D1 & D4 SL-J ASTRO 1,2&3 OSS-2 EOM-1&2 SUNLAB-1&2 SPL

* PCR (FULL SPACELAB AND OTHER PARTIAL), MOR POSSIBLY FOR MSFC PARTIAL

MANIFEST/TRAFFIC MODEL

MISSION	FY	1984	1985	1986	1987	1988

FULL SPACELAB	DEDICATED
	- MODULE
	  - IGLOO
	  - PALLETS
		SL-1	SL-3
			SL-D1
				SL-4	SL-8	SL-J
						SL-10

	MIXED CARGO - IGLOO PALLET		SL-2	ASTRO-1 EOM-1 SUNLAB-1	SL-D4 ASTRO-2 ASTRO-3 SUNLAB-2	EOM-2 OSS-2 SPL
OTHER PARTIALS	MIXED CARGO - MDM PALLET	OSTA-3		OSTA-5 STEP-1	OAST-2 CFMF-1 OSTA-7 STEP-2	OSTA-9 TSS-1 CFMF-2 CFMF-3 STEP-3
	- HITCHHIKER	HH-1	HH-2 HH-3	HH-4 HH-5	HH-6 HH-7	HH-8 HH-9
MSFC PARTIALS	MIXED CARGO - MPESS	MSL-1 OSTA-1 LFC-1	MSL-2	MSL-3 MSL-4 MSL-5	MSL-6 MSL-7 MSL-8 MSL-9 MSL-10	OAST-3 MSL-11 MSL-12 MSL-13 MSL-14 MSL-15

MANIFEST/TRAFFIC MODEL (CONCLUDED)

FY	1984	1985	1986	1987	1988
TOTAL DEDICATED USE OF PCR (MONTHS) (INCLUDES 1 WEEK OPERATIONS)	5	9	14	19	20.5
AVERAGE NUMBER OF PCRs UTILIZED	0.5	1	1	1.5	2
AVERAGE EGSE SPACE REQUIREMENT (SQ. FT.)	500	1400	2000	2100	2400
TOTAL TRAINING REQUIREMENTS (MONTHS)	30	50	78	106	114
AVERAGE NUMBER OF MISSIONS REQUIRING TRAINING PER MONTH	3	4	7	9	10

APOC NETWORK/COMMUNICATIONS
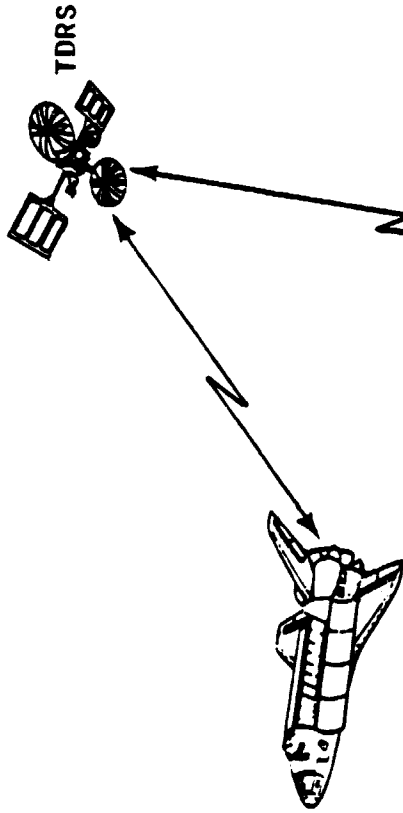
CH. 2 & 3

DOMSAT

CH. 1, 2 & 3

TDRS

TDRSS
GROUND
STATION

DOMSAT
GROUND
STATION

GSFC
SLDPF/SDPF

APOC

△

JSC
MCC

JSC
POCC

ACRONYMS

APOC - Attached Payload Operations Center
DOMSAT - Domestic Satellite
MCC - Mission Control Center
PDI - Payload Data Interleaver
POCC - Payload Operations Control Center
PPF - Payload Parameter Frame
SDPF - Sensor Data Processing Facility
SLDPF - Spacelab Data Processing Facility
SPIF - Shuttle/POCC Interface Facility
STS - Space Transportation System
TDRS - Tracking And Data Relay Satellite
TDRSS - TDRS System

△ DATA TRANSFER INCLUDES

• STS/PAYLOAD PLANNING INFORMATION
• STS ANCILLARY & ORBIT INFORMATION
• PAYLOAD COMMANDS & CMD VERIFICATION
• PDI AND PPF

GSFC APOC SOLUTION

- CAPITALIZES ON EXISTING/PLANNED GSFC FACILITIES AND REMOTE POCC CAPABILITIES

- UTILIZATION OF EXISTING OPERATIONAL ENVIRONMENT PROVIDES LOWER SUSTAINING COSTS

- PROVEN SYSTEMS CAPABILITY PROVIDES LOW RISK ENVIRONMENT

- EXISTING/PLANNED SYSTEM FULLY SUPPORTS NON-SPACELAB ATTACHED PAYLOADS

  -- NO DELTA NON-RECURRING IMPLEMENTATION COST WITH MINIMAL MISSION PECULIAR RECONFIGURATION AS FOR FREE-FLYERS

- SYSTEM AUGMENTATION SATISFIES MANIFEST WITH LOW BUDGET IMPACT

  -- INTERIM CAPABILITY SUPPORTS ASTRO CLASS PAYLOADS WITH LOW RISK

  - MINIMAL HARDWARE PROCUREMENT WITH NO LONG LEAD-TIME ITEMS

  - AVAILABLE LATE 1985

  -- FINAL CAPABILITY SUPPORTS FULL MANIFEST

  - MULTI-SATELLITE OPERATIONS CONTROL CENTER (MSOCC) CAPABILITY UPGRADES PLANNED THROUGH FY86

  - WILL ACCOMMODATE FULL MANIFEST IN 1987

APOC CONCEPT

- Extensive utilization of existing/planned facilities and remote POCC capabilities

- Use existing/planned interface facility with the JSC MCC

- Provide multi-mission environment

- Utilize Electrical Ground Support Equipment (EGSE)

- EGSE transparency for integration and test, simulations, and operations

- Develop flexible expandable capability

- Support both Spacelab and non-Spacelab avionics missions

- Support evolutionary trend to interface/distribution to support remote Principal Investigators (PI)

- Create stable environment for PIs

- Provide transition to free-flyer and/or Space Station

- APOC operational by late 1985, with full capability start of 1987

APOC CONCEPT

APOC MISSION OPERATIONS FUNCTIONAL OVERVIEW (SPACELAB SCENARIO)

ACRONYMS

CMS - Command Management System
DAF - Data Analysis Facility
DQM - Data Quality Monitoring
ECIO - Experiment Computer Input Output
EGSE - Electrical Ground Support Equipment
FDF - Flight Dynamics Facility
MPS - Mission Planning System
MSOCC - Multi-Satellite Operations Control Center
PGSE - Payload Ground Support Equipment
SLDPF - Spacelab Data Processing Facility
SOCC - Science Operations Control Center
SPIF - Shuttle/APOC Interface Facility

APOC CONCEPT
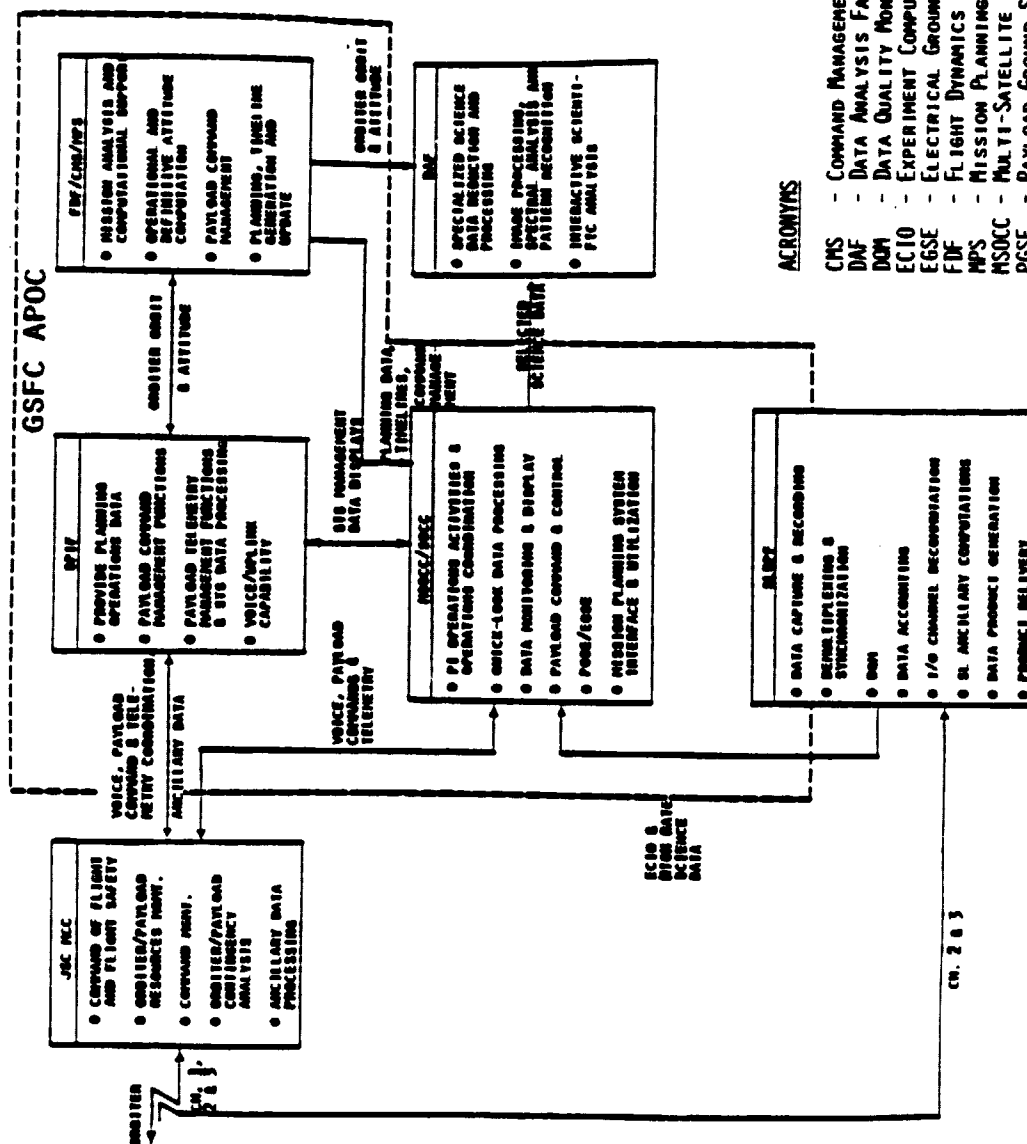
APOC MISSION OPERATIONS CONFIGURATION
(SPACELAB SCENARIO)
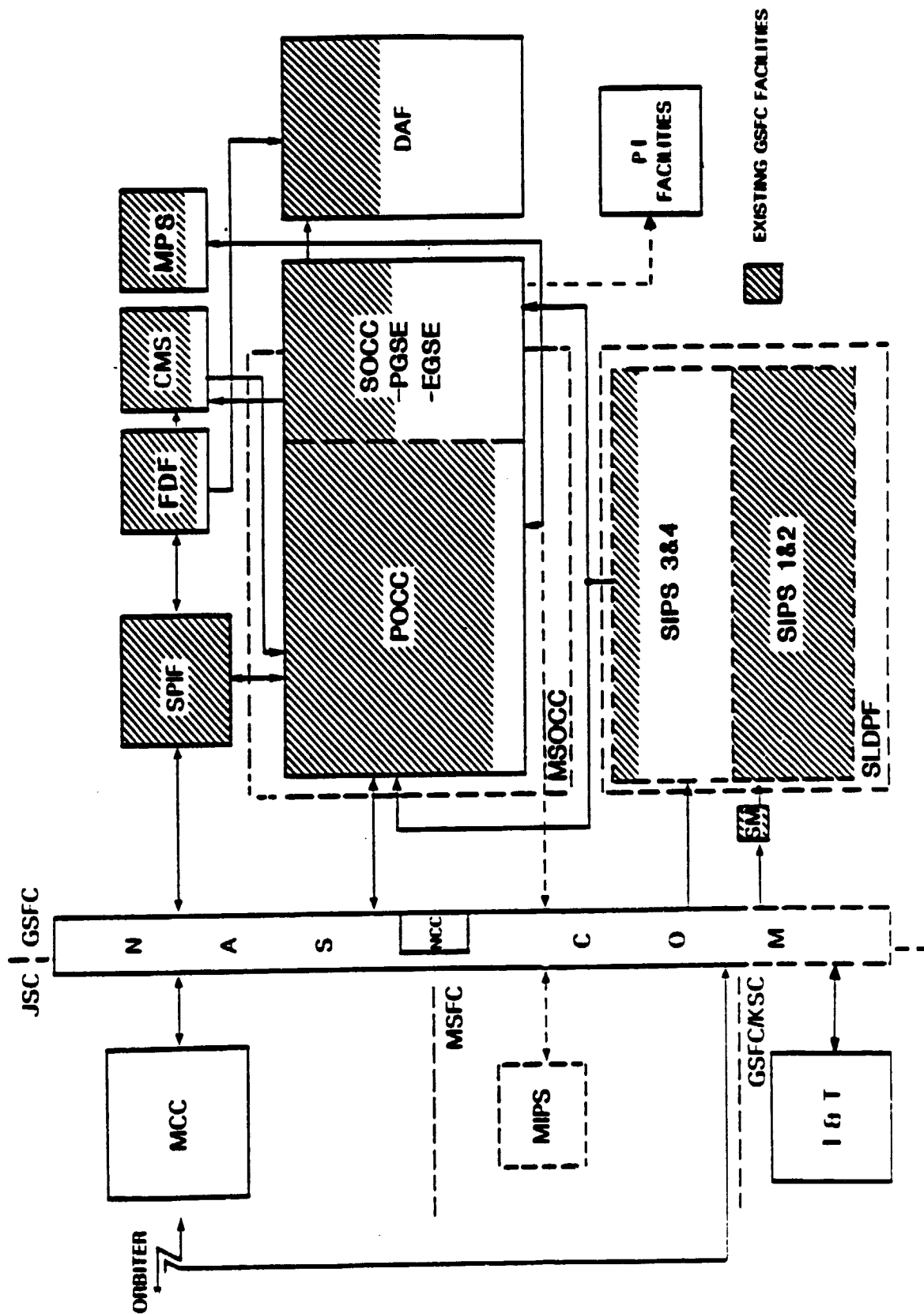
EXISTING EXPERIENCE/CAPABILITIES

- HANDS-ON EXPERIENCE ON OSS-1

- COMPLEX STS MISSION SUPPORT

  - SMM REPAIR [APRIL 1984]

  - ERBS LAUNCH [AUGUST 1984]

- TWENTY-FOUR HOUR/DAY OPERATIONAL ENVIRONMENT

- SCIENCE OPERATIONS CONTROL CENTERS (SMM, IUE)

- DATA ANALYSIS FACILITY (IUE)

EXISTING EXPERIENCE/CAPABILITIES
EXISTING FACILITIES

FACILITY	FUNCTION
Multi-satellite Operations Control Center (MSOCC)	Multi-mission POCC environment for up to six (6) simultaneous missions plus software development
Shuttle/POCC Interface Facility (SPIF)	Centralized STS capabilities/management functions
Spacelab Data Processing Facility (SLDPF)/ Sensor Data Processing Facility (SDPF)	Centralized data input processing system and data output processing
Mission planning system	Extensive capability with tools necessary to minimize system workload/iteration and link to mature CMS
Command Management System (CMS)	Payload command management
Flight Dynamics Facility (FDF)	Mission analysis and computational support, and operational and definitive attitude computation
Integration and test	Building 7/10 facility
Science Operations Control Center (SOCC)/ Data Analysis Facility (DAF)	Enhanced science data processing capability providing increased operational flexibility with commensurate increased scientific return/ guest observer support capacity

APOC ADVANTAGES/DISADVANTAGES
SINGLE/DISTRIBUTED CENTER POCC PHILOSOPHY

MULTI-CENTER

ADVANTAGES

- POTENTIAL FOR PROVIDING FOCUS FOR DISCRETE APPLICATIONS RESIDENT AT VARIOUS NASA CENTERS

- POTENTIAL TO PROVIDE INCREASED UTILIZATION OF VARIOUS NASA CENTERS CAPABILITIES

- DISTRIBUTION OF LOADING

- INCREASED CONSIDERATION OF USER GEOGRAPHICAL DISTRIBUTION

DISADVANTAGES

- POTENTIAL FOR INCREASED USER INTERFACES

- DUPLICATION OF RESOURCES

- INCREASED TRAINING AND COORDINATION

- INCREASED DATA INTERFACE REQUIREMENTS

SINGLE CENTER
(E.G. JSC POCC & APOC)

ADVANTAGES

- PREDOMINATE NASA EXPERIENCE BASE IN SINGLE CENTER GROUND SYSTEMS

- STANDARD USER INTERFACE

- PROXIMITY OF OPERATIONS PERSONNEL

- MINIMIZATION OF DATA INTERFACES

- HIGHER POTENTIAL FOR DISTRIBUTION OF OVERHEAD

- INCREASED SKILLS RETENTION AND TRANSFER FROM MISSION TO MISSION

DISADVANTAGES

- SINGLE POCC BOTTLENECK POTENTIAL

- IMPEDES UTILIZATION OF FULL CAPABILITY OF THE VARIOUS NASA CENTERS

- INSUFFICIENT CONSIDERATION OF USER GEOGRAPHICAL DISTRIBUTION

APOC ADVANTAGES/DISADVANTAGES
APOC/JSC POCC COMPARISON

ITEM	APOC DIFFERENCE
DISADVANTAGES	
DATA STREAM DISTRIBUTION/SUBSET EXTRACTION	• MISSION PECULIAR CONFIGURATION FOR DATA STREAMS OVER 10 MBPS
OPERATIONS COORDINATION	• ADDITIONAL PAYLOAD OPERATIONS COORDINATION PERSONNEL REQUIRED AT JSC • INCREASED DEPENDENCE ON LONG DISTANCE COMMUNICATIONS • FACE-TO-FACE COORDINATION BETWEEN MCC AND APOC PERSONNEL PRECLUDED
ADVANTAGES	
DATA STREAM DISTRIBUTION/SUBSET EXTRACTION	• 4000 PARAMETERS/SEC PROCESSING CAPABILITY • EASE OF EXPANDABILITY
ENVIRONMENT	• MULTI-MISSION
SYSTEM CONFIGURATION	• EASE OF MISSION UNIQUE IMPLEMENTATION/TRANSITION FLEXIBILITY
USER TERMINALS	• HIGHER EGSE COMMAND DATA TRANSFER INPUT RATE • INCREASED USER PROGRAMMABILITY • MISSION PLANNING DATA ACCESS • STANDARD LOW-COST OFF-THE-SHELF EQUIPMENT
STRIP CHART RECORDERS	• UP TO 7 AVAILABLE

APOC ADVANTAGES/DISADVANTAGES
APOC/JSC POCC COMPARISON (CONCLUDED)

ITEM	APOC DIFFERENCE

ADVANTAGES (CONCLUDED)

DESIGN APPROACH
- DISTRIBUTED PROCESSING
- SYSTEM CONFIGURATION FLEXIBILITY
- VIRTUAL INTERFACE PROCESSOR (VIP) SWITCHING ADAPTABILITY
- ENHANCED USER TERMINAL CONTROL
- EQUIPMENT STATE-OF-THE-ART PLANNED UPGRADE
- HARDWARE/SOFTWARE DESIGN APPROACH UTILIZES CURRENT PROVEN GSFC OPERATIONAL SYSTEMS TECHNIQUES [SUBSTANTIAL COST ADVANTAGES WITH MINIMAL RISK INCREASE]

USER INTERFACE
- FULL FUNCTION WITH MISSION PLANNING, I&T AND DATA ANALYSIS SUPPORT

APOC ADVANTAGES/DISADVANTAGES
ADVANTAGES OF THE APOC AT GSFC

● PROVIDES TRANSITION FROM SORTIE MODE "TEST OF CONCEPT" TO FREE-FLYER/SPACE STATION

● PROVEN OPERATIONS CAPABILITY AND EXPERIENCE BASE

● EXTENSIVE USER INTERFACE EXPERIENCE

● BUILDS UPON THE SUCCESSFUL SCIENCE AND APPLICATIONS OPERATIONS/ANALYSIS CAPABILITY

● ACCESSIBILITY TO THE HIGH PERCENTAGE OF RESEARCH INSTITUTIONS AND PERSONNEL IN THE N.E.
  AREA (WITHIN ABOUT 400 MILES OF GSFC)

● REQUIRED DESIGN APPROACH VIA AUGMENTATION OF EXISTING OPERATIONAL FACILITIES

● PROVIDES AUGMENTATION OF THE SLDPF AS AN ADDED BENEFIT

APOC DEVELOPMENT RISKS

A LOW DEVELOPMENT RISK HAS BEEN IDENTIFIED FOR PHASED APOC CAPABILITY TO SUPPORT FULL MANIFEST BASED ON:

● SOLID EXISTING CAPABILITY AND EXPERIENCE BASE

-- EXISTING NON-SPACELAB SUPPORT CAPABILITY

-- PROVEN OPERATIONAL CAPABILITY

-- EXTENSIVE USER INTERFACE EXPERIENCE

-- DEMONSTRATED EASE OF MISSION UNIQUE CONFIGURATION/TRANSITION FLEXIBILITY

-- EXISTING MULTI-MISSION ENVIRONMENT

● PROPOSED LOW RISK AUGMENTATION FOR APOC SUPPORT

-- PROPOSAL AN EXTENSION OF CURRENT SYSTEMS DEVELOPMENT PHILOSOPHY

-- NO LONG LEAD-TIME PROCUREMENTS FOR INTERIM CAPABILITY

-- HIGH CONFIDENCE IN COST ESTIMATES BASED ON DEMONSTRATED EXPERIENCE BASE

GODDARD SPACE FLIGHT CENTER
APPROVAL
ACCOMP.

APOC TRANSITION

Page   of

ORIG. APPL. 10/ 6/83
LAST CHANGE / /
STATUS AS OF / /

#	MILESTONES	86: J F M A M J J A S O N D	87: J F M A M J J A S O N D
01	APOC MISSIONS		
02	ASTRO-1	▷ (M)	
03	ASTRO-2	▷ (O)	
04	MSL-6		▷ (J)
05	SL-D4		▷ (M)
06	OSTA-8		▷ (A)
07	ASTRO-3		▷ (J)
08	OAST-2		
09	MSL-7		▷ (S)
10	EOM-B		▷ (O)
11			
12	JSC MISSIONS		
13	OSTA-5	▷ (M)	
14	MSL-4	▷ (A)	
15	EOM-1	▷ (O)	
16	OSTA-7		▷ (A)
17	SL-8		▷ (M)
18	UNASSIGNED MISSIONS		
19	SUNLAB, CFMF, STEP-2		
20	HH, OTHER PARTIALS		

Note: UNASSIGNED MISSIONS CAN BE SUPPORTED BY EITHER POCC, DEPENDING ON SCHEDULE

SCHEDULE SUMMARY

5 YEAR

MILESTONE SCHEDULE

(LEVEL)

PROJECT ATTACHED PAYLOAD OPERATIONS CENTER (APOC) IMPLEMENTATION

CENTER _____

RESPONSIBILITY: _____

APPROVAL _____

ACCOMPLISHMENT _____

ORIGINAL SCHEDULE APPROVAL _____ (Date)

LAST SCHEDULE CHANGE _____ (Date) (No) (Initials)

STATUS AS OF _____ (Date) (Initials)

	MILESTONES	CY 19 83	CY 19 84	CY 1985	CY 19 86	CY 19 87
1	ROMT. DEFINITION AND ANALYSIS					
2	SYSTEM DESIGN					
3	INTERIM IMPLEMENTATION					
4	FINAL IMPLEMENTATION					
5	INTERIM TEST AND TRAINING					
6	FINAL TEST AND TRAINING					
7						
8						
9						
10						
11						
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14						
15						
16						
17						
18						
19						
20						

NOTES

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COST AND MANPOWER [SUMMARY]

| | MANPOWER [M.YRS] | | COSTS [FY83 K$] | | | | |
	C.S.	CONTRACTOR	TRAVEL	CONTRACTOR	HARDWARE	TOTAL	TOTAL WITH CONTINGENCY
NON-RECURRING							
DEVELOPMENT	30.7	56.5	36	3390	4505	7931	9121
△ FOR ASTRO-1 SUPP.	0.3	5.8	-	348	25	373	429
RECURRING							
SUSTAINING BASE	3.5	17	-	1020	549	1569	-
PER MISSION [AVERAGE]	1.9	6.2	18	370	4	392	451

APOC SUMMARY

> PHASED APPROACH AUGMENTS EXISTING MULTI-MISSION ENVIRONMENT, FLEXIBILITY, AND CAPABILITY TO SUPPORT FULL MANIFEST WITH LOW RISK AND BUDGET IMPACT

DESIGN APPROACH

- MULTI-MISSION ENVIRONMENT

- SUPPORTS MISSION PLANNING, I&T, OPERATIONS AND DATA ANALYSIS

- EGSE UTILIZATION THROUGH ALL MISSION PHASES

- SUPPORTS SPACELAB AND NON-SPACELAB MISSIONS

- TRANSITION FROM SORTIE MODE "TEST OF CONCEPT" TO FREE-FLYER

ADDED BENEFIT

- REQUIRED SLDPF AUGMENTATION

- DATA ANALYSIS FACILITY INCORPORATION

- REMOTE OPERATIONS CENTER DEVELOPMENT

LOW COST

- MAXIMUM UTILIZATION OF EXISTING FACILITIES AND EXPERTISE

- IMPLEMENTATION APPROACH WITH LOW BUDGET IMPACT

- EXISTING 24-HOUR/DAY YEAR AROUND OPERATIONAL ENVIRONMENT

- DISTRIBUTION OF OVERHEAD (SUSTAINING COSTS)

LOW RISK

- EXISTING NON-SPACELAB SUPPORT CAPABILITY

- PROVEN OPERATIONAL CAPABILITY AND EXPERIENCE BASE

- EXTENSIVE USER INTERFACE EXPERIENCE

- NO LONG LEAD-TIME HARDWARE PROCUREMENTS FOR INTERIM SYSTEM

POCC CAPABILITIES

● EXISTING NON-SPACELAB ATTACHED PAYLOAD SUPPORT CAPABILITY

● APOC OPERATIONAL REQUIREMENTS OVERVIEW

● DETAILED APOC CAPABILITIES

    -- TELEMETRY
    -- COMMAND
    -- VOICE/VIDEO
    -- ATTITUDE AND TRAJECTORY
    -- NRT
    -- FACILITY (CONSOLES, SPACE, CONFERENCING)
    -- TRAINING
    -- COMMUNICATIONS AND INTERFACES

● APOC CONFIGURATION

● MANIFEST SATISFACTION AND POCC UTILIZATION

EXISTING NON-SPACELAB ATTACHED PAYLOAD SUPPORT CAPABILITY

- OPERATIONS/USER SUPPORT AREAS/ROOMS WITH EXTENSIVE CONSOLE, INTELLIGENT TERMINAL, CCTV AND STRIP CHART RECORDER (SCR) CAPABILITY

- PROCESSING OF PAYLOAD DATA INTERLEAVER (PDI) & PAYLOAD PARAMETER FRAME (PPF) DATA

- PROCESSING OF 2,000 PARAMETERS/SEC FROM PAYLOAD DATA CURRENTLY WITH UP TO 4,000 PARAMETERS/SEC [1/86]

- MISSION CONTROL CENTER (MCC) COMMAND CAPABILITY

- ELECTRICAL GROUND SUPPORT EQUIPMENT (EGSE) INTERFACE TO MULTIPLEXOR/DE-MULTIPLEXOR (MDM) OR STATISTICAL MULTIPLEXOR (CAPABILITY AVAILABLE AT MINIMAL COST)

- VOICE AND VIDEO DISPLAY

- TEXT AND GRAPHICS SYSTEM (TAGS) [1/85]

- SHUTTLE/POCC INTERFACE FACILITY (SPIF) PROCESSING & DISPLAY OF ANCILLARY AND ORBIT DATA

EXISTING NON-SPACELAB ATTACHED PAYLOAD SUPPORT CAPABILITY

EXISTING* APOC CONFIGURATION

ORIGINAL PAGE IS
OF POOR QUALITY

* INCLUDES CURRENTLY PLANNED
  SYSTEM UPGRADES

ACRONYMS

AP — APPLICATIONS PROCESSOR
APOC — ATTACHED PAYLOAD OPERATIONS CENTER
CAP — COMMAND ACCEPTANCE PATTERN
CCTV — CLOSED CIRCUIT TELEVISION
EGSE — ELECTRICAL GROUND SUPPORT EQUIPMENT
JSC — JOHNSON SPACE CENTER
MCC — MISSION CONTROL CENTER
MSOCC — MULTI-SATELLITE OPERATIONS CONTROL CENTER

NASCOM — NASA COMMUNICATIONS NETWORK
NGT — NASA GROUND TERMINAL
PDI — PAYLOAD DATA INTERLEAVER
PPF — PAYLOAD PARAMETER FRAME
SM — STATISTICAL MULTIPLEXOR
SOCC — SCIENCE OPERATIONS CONTROL CENTER
SPIF — SHUTTLE/POCC INTERFACE FACILITY
TAC — TELEMETRY AND COMMAND

EXISTING NON-SPACELAB ATTACHED PAYLOAD SUPPORT CAPABILITY
PLANNED MSOCC UPGRADES

ELEMENT	CY 1983	CY 1984	CY 1985	CY 1986	CY 1987
LAN					
System Operational		6/84 ▽			
AP Processor Upgrade					
RFP	1/84 ▽				
System Operational				1/86 ▽	
TAC Processor Upgrade					
(11/34 to 11/44)	11/83 ▽				
System Operational		10/84 ▽			
DOC					
(Two (2) VAX 11/780s)					
Installation			5/85 ▽		
System Operational					
VIP Switching					
(Display System Augmentation)					
RFP		5/84 ▽			
Initial System Operational			9/85 ▽		

ACRONYMS

AP   - Applications Processor
DOC   - Data Operations Control
LAN   - Local Area Network
MSOCC - Multi-Satellite Operations Control Center
TAC   - Telemetry and Command
VIP   - Virtual Interface Processor

APOC OPERATIONAL REQUIREMENTS OVERVIEW

Functional Requirement	Existing	Capability Augmentation Required	New Requirement
Telemetry Acquisition & Preprocessing (Deblock, Demultiplex, Decommutate, Preprocess, Record, & Route)			
STS Operational Downlink			
STS Parameter Data	X	X	
PDI Data	X	X	
PPF Data	X	X	
STS Ancillary Data	X	X	
STS Telemetry Status	X	X	
Spacelab HRM			
HRM Experiment Channels		X	
HRM DAC			
SSIU			
ECIO			
HDRR			
PR			
GMT			
Telemetry Processing, Display & Control			
Processing			
Engineering unit conversion	X		
Limit Check & Warning	X		
Special Computations	X	X	
On-line Storage & Retrieval			
Trend Analysis	X		

APOC OPERATIONAL REQUIREMENTS OVERVIEW (CONTINUED)

FUNCTIONAL REQUIREMENT	EXISTING	CAPABILITY AUGMENTATION REQUIRED	NEW REQUIREMENT
TELEMETRY PROCESSING, DISPLAY & CONTROL (CONT.)			
DISPLAY			
CRT (COLOR)	X	X	
HARDCOPY/PRINTOUT (COLOR & BW)	X		
SCR			
CONTROL			
(R-T, NRT, & PLANNED)			
USER DEFINED COMPUTATIONS	X	X	
USER DEFINED DISPLAYS	X		
APOC CONFIGURATION			
STS/MCC DISPLAYS			
MCC STATUS	X		
STS ANCILLARY DATA	X		
STS ORBIT & ATTITUDE	X		
R-T COMMAND INFO.	X		
CAP	P		
PAYLOAD COMMANDING			
REALTIME	X	S	
TIME TAGGED	X		
DISCRETE	X		
GROUP	X		
PROCEDURE	X		
RESTRICTED	X		
CRITICAL	X		

S = AUGMENTATION OF PAYLOAD COMMANDING FUNCTIONS FOR SPACELAB

P = PLANNED

FUNCTIONAL REQUIREMENT	EXISTING	CAPABILITY AUGMENTATION REQUIRED	NEW REQUIREMENT
PAYLOAD COMMANDING (CONT.)			
VALIDATION	X		
HISTORY	X		
CMS I/F	X		
SUPPORT COMPUTING			
COMMAND MANAGEMENT	X		
PLANNING DATA PROCESSING	X		
COMMAND MEMORY LOAD PREPARATION	X		
SENSOR MISALIGNMENT CALIBRATION	X		
ATTITUDE COMPUTATION	X		
DETERMINATION	X		
DEFINITIVE DETERMINATION	X		
MANEUVER SUPPORT	X		
ORBIT COMPUTATION	X		
DETERMINATION	X		
PREDICTION	X		
DEFINITIVE DETERMINATION	X		
MANEUVER SUPPORT	X		
SCIENCE DATA PROCESSING (R-T & NRT)			
SPECIALIZED SCIENCE DATA	X		
REDUCTION & PROCESSING			
IMAGE PROCESSING	X		
SPECTRAL ANALYSIS	X		

APOC OPERATIONAL REQUIREMENTS OVERVIEW (CONTINUED)

Functional Requirement	Existing	Capability Augmentation Required	New Requirement
Science Data Processing (R-T & NRT) (cont.)			
Pattern Recognition	X		
Statistical Processing	X		
Color Display & Hardcopy	X		
Interactive User Control	X		
Operations/Support Facilities			
Mission Operations Rooms	X		
Payload Control Rooms [PCR]		X	
Mission Analysis Rooms	X		
EGSE Rooms		X	
IDA Support Rooms	X		
Conference Rooms	X		
Teleconferencing Facilities	X		
CCTV	X		
FTS	X		
Test & Simulation			
Recorded Payload Data	X		
Payload Simulator		X	
Interface Testing	X		
Database Validation	X		
Mission Plan Validation	X		
Personnel Training	X		
EGSE Testing	X		
MCC Simulator	X		

APOC OPERATIONAL REQUIREMENTS OVERVIEW (CONCLUDED)

FUNCTIONAL REQUIREMENT	EXISTING	CAPABILITY AUGMENTATION REQUIRED	NEW REQUIREMENT
COMMUNICATIONS			
PAYLOAD DATA-HRM	X		
(CHANNEL 2&3)			
STS OPERATIONAL DOWNLINK	X		
(CHANNEL 1 - VIA SPIF)			
PDI, PRÍ, & STS ANCILLARY	X		
VIDEO (150 CHANNELS, HR COLOR)	X	X	
VOICE	X		
A/G, SPACELAB, & MCC	X		
PAYLOAD COMMAND	X		
APOC EXTERNAL I/F's			
MCC	X		
APOC INTERNAL I/F's			
CMS	X		
FDF	X		
OSCF	X		
SLDPF		X	
DAF		X	
EGSE			
- ECIO		X	
- HRDM CHANNELS		X	
- STS OD	X		

DETAILED APOC CAPABILITIES

TELEMETRY
OPERATIONAL REQUIREMENTS

- RECEIVE, ROUTE, PROCESS AND DISPLAY OF STS OD DATA AS PROVIDED BY THE MCC

- RECEIVE, STORE ON HIGH DENSITY TAPE DRIVES (HDTD) FOR POSSIBLE PLAYBACK CHANNEL 2 AND 3 (HRM R/T AND PLAYBACK DATA FOR SPACELAB)

- DECOM AND SYNCH HRM R/T AND PLAYBACK DATA AND ROUTE TO APOC PROCESSOR, EGSE OR REMOTE

- PERFORM DATA QUALITY MONITORING (CONDUCTED WITHIN SLDPF FOR SPACELAB AND POCC/EGSE FOR NON-SPACELAB PAYLOADS)

- PROCESS ENGINEERING AND SCIENCE (MAXIMUM INPUT RATE OF 2 MBPS FOR UP TO 3 STREAMS) DATA TO SUPPORT HEALTH AND SAFETY, AND QUICK LOOK ANALYSIS FUNCTIONS. MAXIMUM OF 2000 PARAMETERS FOR OPERATIONS SUPPORT, CREW INTERACTION SUPPORT, CONTINGENCY ANALYSES AND PAYLOAD ACTIVITY RESCHEDULING.

- PROVIDE ON-LINE STORAGE AND RECALL OF STS PARAMETERS DATA (500 PARAMETERS MAXIMUM) AND ENGINEERING AND SCIENCE DATA SUBSETS (9200 PARAMETERS MAXIMUM) FOR 24 HOURS

TELEMETRY FUNCTIONAL REQUIREMENTS

FUNCTIONAL REQUIREMENT	STS OD+						SPACELAB HRM R/T OR PLAYBACK												TDRSS DOWNLINK CHANNEL	
	STS PARAMETER	PDI	PDI SUBSET*	STS ANCILLARY	STS TELEMETRY STATUS	R/T & PLAYBACK	DAC	EXPERIMENT CHANNELS	2000 PARAMETERS*	SC10	SC10 SUBSET*	EC10	EC10 SUBSET*	PR	OMT	1	1 SUBSET*	2	2 SUBSET*	3
RECEIVE	X	X	X	X	X	X									X		X		X	
ROUTE AND SELECTIVE DISPLAY	X	X	X	X	X	X									X		X		X	
STORE FOR POSSIBLE RECALL	X	X	X	X	X	X									X		X		X	
HRM DECOM & SYNCH					X															
SUBSET EXTRACTION - CHANNELS	4	4					3	X	X		4				X		X			
ROUTE - APPLICATIONS PROCESSOR	X	X								X	X	X		X		X		X		
ROUTE - EGSE	X	X								X	X	X		X		X		X		
ROUTE - REMOTE		X										X		X		X				
PROCESS - SIMPLE & ARITHMETIC		X	X			X	X	X	X	X	X	X	X	X		X	X	X	X	
PROCESS - TERMINAL DISPLAY		X	X				X	X		X		X		X		X		X		
ON-LINE STORAGE AND RECALL	#		#					a		a		a				a		a		

+ - SUBSET PROCESSED AND PROVIDED BY MCC
* - APDC REQUIREMENT TO EXTRACT SUBSET FROM APPROPRIATE CHANNEL OR DATA STREAM
# - 500 PARAMETERS TOTAL
a - 5200 PARAMETERS TOTAL OF EXPERIMENTER DATA

TELEMETRY

CHANNEL 2 AND 3 RECEIPT, STORAGE, DECOM, SYNCH AND DQM

- UTILIZES GSFC SENSOR DATA PROCESSING FACILITY (SDPF) CAPABILITIES WITH APPROPRIATE UPGRADE OF SLDPF FOR SPACELAB PAYLOADS

- SLDPF AUGMENTED WITH SPACELAB INPUT PROCESSING SYSTEM (SIPS) #4. SIPS #3 & 4 AUGMENTATION INCLUDES:

  -- 2 HIGH DENSITY TAPE DRIVES (HDTD)

  -- 2 HIGH RATE DEMULTIPLEXORS (HRDM)

  -- 2 FRAME SYNC UNITS

  -- 2 SEL COMPUTERS

- SIPS #4 AUGMENTATION UTILIZES PROVEN EXISTING DESIGN APPROACH AND THEREFORE NO SPECIAL PROBLEMS ARE PRESENTED FOR CONFIGURATION AND INTEGRATION OF HRDM EQUIPMENT

- CURRENT SLDPF PERFORMS DATA QUALITY MONITORING (DQM) OF ALL HRDM DATA STREAMS AND PROVIDES STATUS TO JSC FOR OPERATIONAL SUPPORT

- DQM FOR APOC OPERATIONAL SUPPORT WILL UTILIZE ABOVE EXISTING CAPABILITY.

TELEMETRY

SPACELAB FRONT END

* SELECTION FROM 1 OF 16 HRDM
  USER CHANNELS
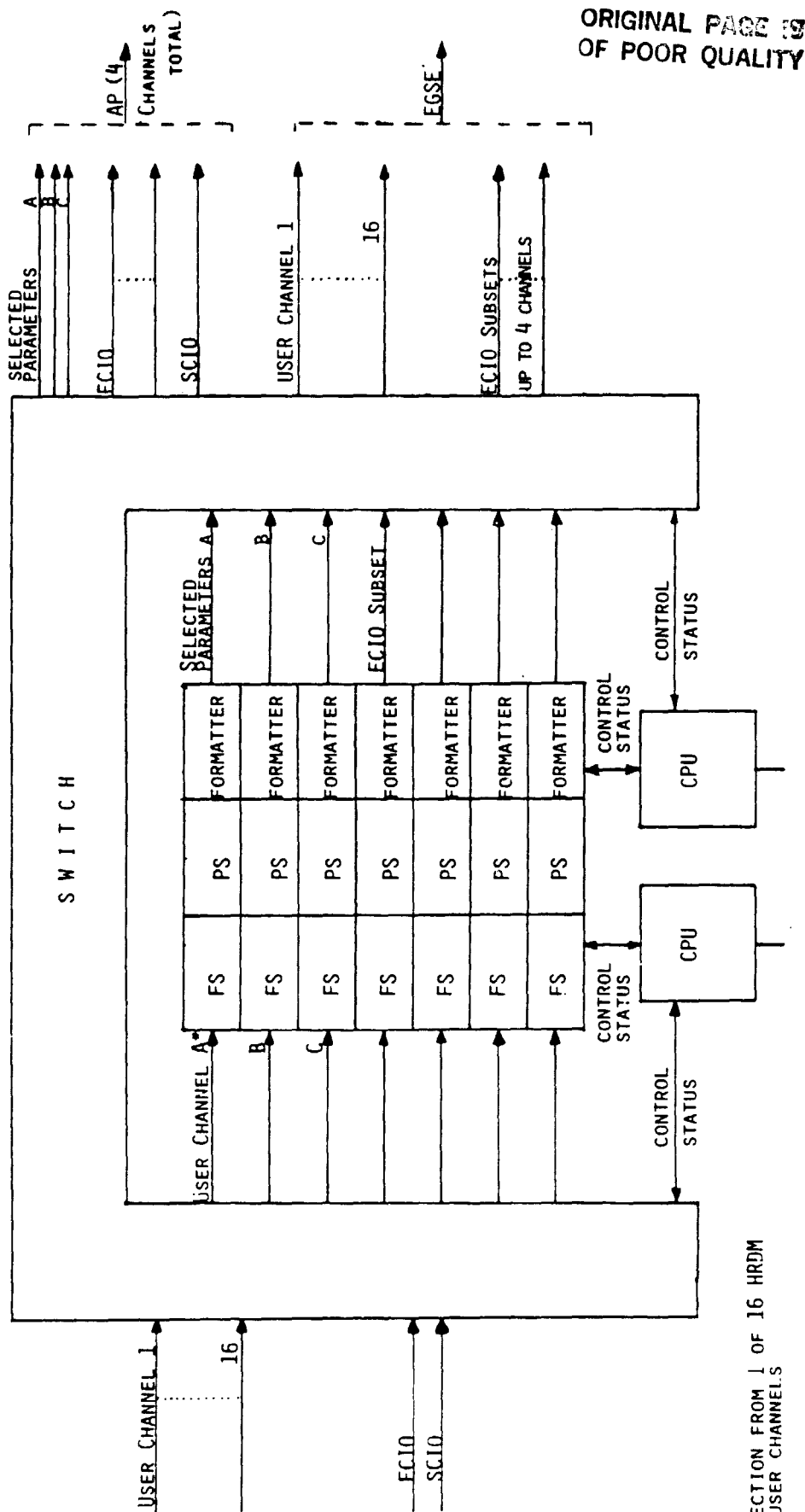
TELEMETRY
ENGINEERING DATA ANALYSIS FUNCTIONS

- CONVERSION TO ENGINEERING UNITS

- CONVERSION OF ANALOG DATA BASED ON SIMPLE ARITHMETIC EXPRESSIONS AND CALIBRATION DATA

- LIMIT CHECKING USING POSSIBLY RED AND YELLOW LIMITS WITH MAINTENANCE OF A LOG OF ALL VIOLATIONS

- MONITORING OF STATUS INDICATOR VALUES, AND MAINTENANCE OF A LOG OF MODE CHANGES AND OF DEVIATIONS FROM THE "NORMAL" VALUE.

- TABULATION OF SELECTED PARAMETERS FOR SELECTED TIME PERIODS.

- GRAPHICAL DISPLAY OF PARAMETER VALUES AS A FUNCTION OF SOME OTHER ENGINEERING PARAMETER.

- HISTOGRAMS OF VALUES OF SELECTED PARAMETERS FOR SELECTED TIME INTERVALS.

- BASIC STATISTICAL ANALYSES ON VALUES OF SELECTED PARAMETERS, SUCH AS MEANS, VARIANCES, RANGES, AND CORRELATION COEFFICIENTS.

COMMAND
OPERATIONAL REQUIREMENTS

REQUIREMENT	CURRENT CAPABILITY
● COMMAND MODE SUPPORTED	
-- TERMINAL TO AP	E
-- EGSE VIA TRANSFER TO AP	E
-- REMOTE VIA TRANSFER TO AP	A
● COMMAND TYPE	
-- REALTIME	
● TIME TAGGED	E
● DISCRETE (ON/OFF)	E
● GROUP	E
● PROCEDURE	E
● RESTRICTED	E
● CRITICAL	E
-- PREPROGRAMMED	
● COMMAND MEMORY LOAD (MMU)	A
● DEP, MICROPROCESSOR LOAD	E
● ECOS/ECAS UPDATES	N
-- UPLINK TECHNIQUE	
● SINGLE STAGE	E
● TWO STAGE	E
● SINGLE STAGE WITH BLOCK ZERO WORD COUNT COMPARISON	N
-- FORMAT	
● SPACELAB	N
● ORBITER (NON-SPACELAB PAYLOADS)	E

KEY
E - EXISTING GSFC CAPABILITY
A - AUGMENTATION OF EXISTING CAPABILITY
N - NEW REQUIREMENT

COMMAND
FUNCTIONAL REQUIREMENTS (SPACELAB)

- COMMANDS TO INITIATE EC OPERATING SYSTEM (ECOS)/EC APPLICATIONS SOFTWARE (ECAS) FUNCTIONS

  (E.G. DEDICATED EXPERIMENT PROCESSOR (DEP) LOAD, TIMELINE MAINTENANCE)

- COMMANDS TO MAKE DATA INPUTS TO ECOS/ECAS (E.G. CONSTANTS, TIMELINE INPUTS)

- EXPERIMENT RAU DISCRETE OUTPUTS (ON/OFF)

- EXPERIMENT RAU SERIAL OUTPUTS

- IPS POINTING COMMANDS THROUGH THE SC (SUPPORTED FROM THE MCC)

VOICE/VIDEO

REQUIREMENTS	CURRENT CAPABILITY	AUGMENTATION
• VOICE LINKS		
AIR TO GROUND (2)	1 FULL DUPLEX/1 SIMPLEX	-
SPACELAB VOICE (2)	SLDPF HRDM OUTPUT	TRANSFER TO APOC AND CONVERSION
MCC INTERFACE (20)	SPIF (10)	10 DEDICATED LINKS
KSC LAUNCH SUPPORT (5)	VIA NASCOM	5 DEDICATED LINKS
MSFC COORDINATION (2)	VIA NASCOM	2 DEDICATED LINKS
REMOTE FACILITIES	VIA NASCOM	-
INTERNAL	EXISTING GSFC INTERNAL	-
• VOICE RECORD/PLAYBACK	-	VOICE RECORDERS (TBD)
• A/G VIDEO	DISPLAY/RECORD/PLAYBACK	-

ATTITUDE AND TRAJECTORY
FUNCTIONAL REQUIREMENTS

REQUIREMENTS

	CURRENT CAPABILITY
• ATTITUDE DETERMINATION	A
• ATTITUDE MANEUVER COMPUTATIONS	N
• ATTITUDE DYNAMICS EVALUATION	N
• ATTITUDE SENSOR PERFORMANCE ANALYSIS	N
• ANALYSIS OF OPERATIONS CRITICAL TO THE HEALTH AND SAFETY OF THE SPACE SEGMENT DURING ATTITUDE MANEUVERS	A
• ORBIT MISSION ANALYSIS	E
• LAUNCH WINDOW ANALYSIS	E
• ORBIT MANEUVER PLANNING AND EVALUATION	N
• REALTIME MONITORING AND CORRECTION OF ORBIT MANEUVERS	N
• TRAJECTORY/ORBIT DETERMINATION	E
• TRACKING SYSTEM PERFORMANCE ASSESSMENT	E
• MISSION MANEUVER SUPPORT.	N

SUPPORT ELEMENTS

- • JSC PROVIDED STS OD AND ANCILLARY DATA
- • SPIF STS STANDARD SUPPORT CAPABILITY
- • GSFC INSTITUTIONAL CAPABILITY

KEY

E - EXISTING GSFC CAPABILITY
A - AUGMENTATION OF EXISTING CAPABILITY
N - NEW REQUIREMENT

ATTITUDE AND TRAJECTORY
SPIF CAPABILITIES FOR SUPPORTING MISSIONS UTILIZING THE STS

● PLANNING AND COORDINATION FUNCTIONS FOR ASSISTANCE IN MISSION PLANNING AND THE INTEGRATION OF PAYLOADS INTO STS OPERATIONS.

● DELIVERY OF PRE-FLIGHT PLANNING DATA CONTAINING ORBITER TRAJECTORY DATA.

● CCTV DISPLAY OF ORBIT TRACKING DATA (EVERY 3 MINUTES UNDER TIMELINE CONTROL OR BY REQUEST) AND 2 HOUR PROJECTIONS SHOWING ALL PLANNED ORBITER MANEUVERS.

● CCTV DISPLAY OF ORBITER ATTITUDE DATA (EVERY 12 SECONDS UNDER TIMELINE CONTROL OR BY REQUEST). REALTIME AND PROJECTED DATA (NEXT 48 HOURS) ARE AVAILABLE.

● TRANSFER OF CREW ACTIVITY PLAN (CAP) INFORMATION FROM JSC WITH FORMATTING FOR USER DISPLAY [PLANNED CAPABILITY].

● RECEIPT OF PROCESSED OPERATIONAL DOWNLINK (OD) DATA AND BUILDING OF DISPLAYS FOR USER CCTV DISPLAY [PLANNED CAPABILITY].

● IMAGERY UPLINK TO THE ORBITER VIA THE TAGS [PLANNED CAPABILITY]

NEAR-REALTIME (NRT)

APOC ON-LINE DATA BASE AND NRT PROCESSING SUPPORT

- REQUIREMENT

  -- ON DEMAND ACCESS ON SHARED BASIS
  -- RECALL AND PROCESS TELEMETRY AND HISTORY DATA
  -- ACCESS TO REALTIME TELEMETRY PROCESSING CAPABILITIES
  -- HISTORY REPORT GENERATION
  -- OUTPUT TO APOC TERMINAL AND ASSOCIATED PERIPHERALS

- CAPABILITY

  -- HIGH DATA TAPE RECORDER PLAYBACK
  -- REDUNDANT HRDM
  -- ON-LINE STORAGE ACCESS [500 STS PARAMETERS AND 9200 PAYLOAD PARAMETERS]
  -- INPUT/OUTPUT PERIPHERAL QUEUING

FACILITY (CONSOLES, SPACE, CONFERENCING)
CONSOLES/STRIP CHART RECORDERS

- CONSOLES [MSOCC UPGRADE FOR APOC SUPPORT]

  -- VIRTUAL INTERFACE PROCESSOR (VIP) SWITCHING [CURRENTLY PLANNED TO BE OPERATIONAL 9/85]

  -- TERMINAL UPGRADE - 40 PCs WITH FLOPPY AND DOT MATRIX PRINTER

- STRIP CHART RECORDERS (SCR)

  -- UP TO SEVEN (7) SCRs CAN BE MADE AVAILABLE TO APOC

FACILITY (CONSOLES, SPACE, CONFERENCING)

FLOOR PLAN

ORIGINAL PAGE IS
OF POOR QUALITY

ACRONYMS:

CMS - Command Management System
DOC - Data Operations Control
MOR - Mission Operations Room
MSR - Mission Support Room
OSC - Operations Support Center
PCR - Payload Control Room
PSR - Payload Support Room
SMM - Solar Maximum Mission
SPIF - Shuttle/POCC Interface Facility

MSR

PSR

MOR 6

MOR 7

SMM MOR

DOC

SPIF MOR

MSR

PCR 1

MOR 1

EQUIPMENT OPERATIONS AREA

MOR 2

MOR 3

MOR 4

EQUIPMENT ROOM

DOC

PCR 2 (MOR 5)

CMS EQUIPMENT AREA

CMS MOR

MSR

XEROX

SCHEDULING ROOM

OSC

PROPOSED APOC OPERATIONAL AREAS

FACILITY (CONSOLES, SPACE, CONFERENCING)

FLOOR PLAN (CONTINUED)

ST MSR	ST MSR
ST OPERATIONS AREA	
ST MOR	
IUE OPERATIONS AREA	
IUE MOR	
DOC	
USER EGSE AREA	
IUE MSR	
MSR	
TECH SUPPORT	
MOR LOGISTICS	
DOC	
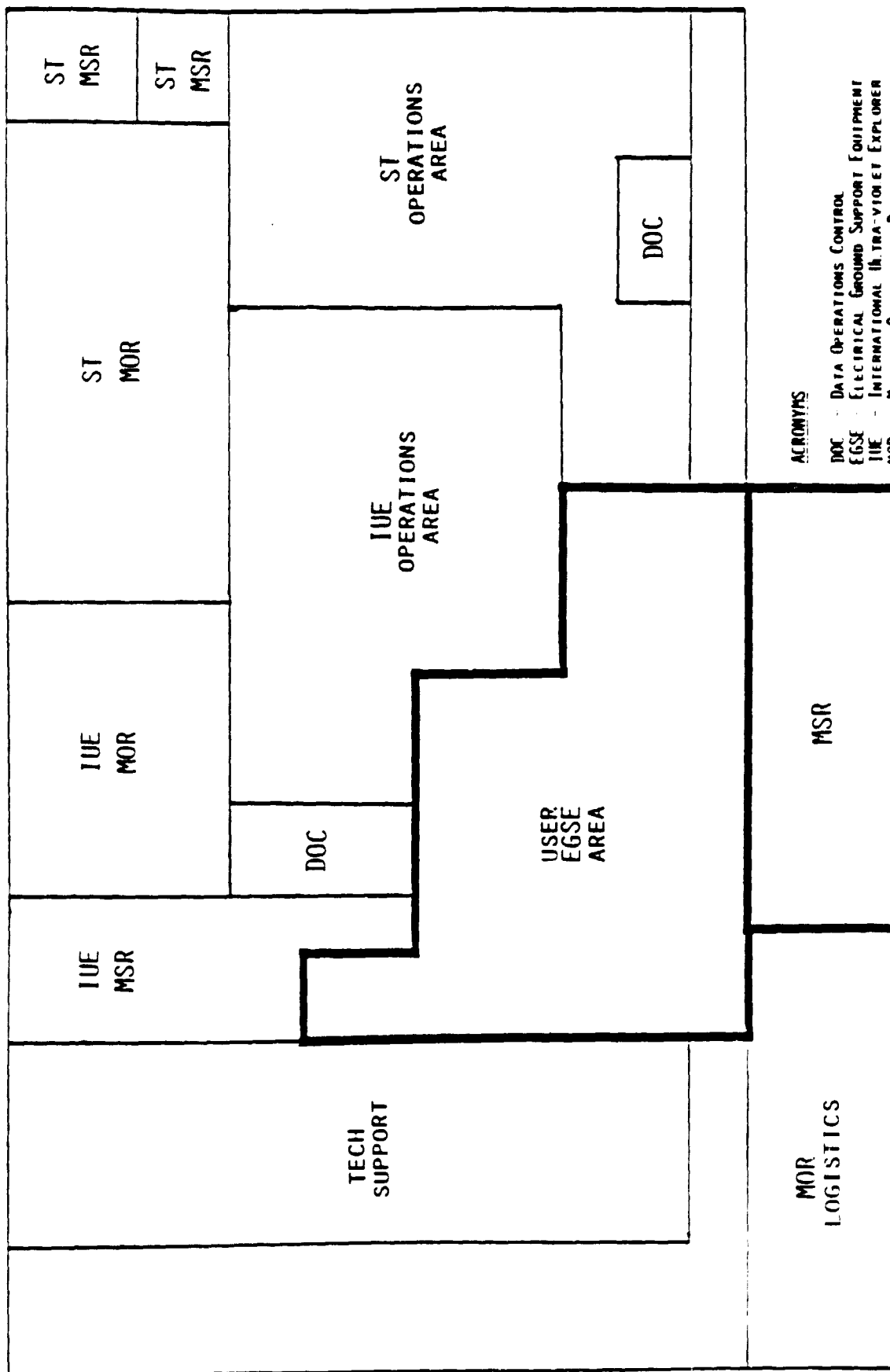
ACRONYMS

DOC - Data Operations Control
EGSE - Electrical Ground Support Equipment
IUE - International Ultra-violet Explorer
MOR - Mission Operations Room
MSR - Mission Support Room
ST - Space Telescope

FACILITY (CONSOLES, SPACE, CONFERENCING)
FLOOR SPACE (SQ. FT.)

ROOM(S)	OPERATIONAL	EGSE	SUPPORT
PCR 1	600		
PCR 2 (EXPANDED MOR 5)	700		
MOR 1	300		
MOR 4	300		
MOR 7	560		
PSR			530
USER EGSE AREA		2600	
MSR			1560
TOTAL	2460	2600	2090

TRAINING

- REQUIREMENT TO TRAIN

  -- APOC OPERATIONS PERSONNEL
  -- MISSION MANAGER PERSONNEL
  -- USERS

- TRAINING INCLUDES

  -- APOC SYSTEM TRAINING
    - CONFIGURATION
    - SYSTEM UTILIZATION
    - PCR/MOR CONSOLE OPERATION
    - TERMINAL COMMAND TELEMETRY AND DISPLAY FUNCTIONS
    - EGSE UTILIZATION
    - INTERFACE AND COORDINATION

  -- STS SYSTEM TRAINING
    - MCC/APOC INTERFACE
    - KSC/MSFC/REMOTE FACILITY TO APOC INTERFACE
    - END-TO-END SYSTEMS TEST [MISSION MANAGER COORDINATED]

- CAPABILITIES

  -- SIMULATED OR ACTUAL DATA INPUT INTO HRDM VIA HIGH DENSITY TAPE DRIVE (HDTD)
  -- UTILIZATION OF STANDARD APOC ROUTING AND PROCESSING FUNCTIONS
  -- MCC COMMUNICATIONS INTERFACE TO APOC SIMULATION VIA SPIF

COMMUNICATIONS AND INTERFACES
APOC COMMUNICATIONS REQUIREMENTS

REQUIREMENT	MISSION REQUIREMENT		GSFC	
	INDEPENDENT	DEPENDENT	STATUS	COMMENTS
● DATA				
-- KU BAND CHANNEL 3 [50 MBS HRM/ ANALOG/DAC]	X		E	SLDPF
-- KU BAND CHANNEL 2 [2 MBS HRM]	X		E	SLDPF
-- ORBITER OI/MCC ANCILLARY	X		E	SPIF
● COMMAND				
-- SPACELAB	X		A	STS (SPIF)
-- TAGS	X		P	SPIF
● VOICE				
-- AIR TO GROUND (2 CHANNELS)	X		E	SPIF
-- SPACELAB VOICE (2 CHANNELS)	X		E	SLDPF
-- MCC INTERFACE (20 CHANNELS)	X		A	SPIF (10)
-- KSC LAUNCH SUPPORT	X		A	MSOCC (5)
-- MSFC INTERFACE	X		A	MSOCC (2)
-- INTERNAL	X	X	E	SPIF/MSOCC/ SLDPF

KEY
E - EXISTING GSFC CAPABILITY
P - PLANNED GSFC CAPABILITY
A - AUGMENTATION OF EXISTING CAPABILITY
N - NEW REQUIREMENT

COMMUNICATIONS AND INTERFACES
APOC COMMUNICATIONS REQUIREMENTS (CONCLUDED)

REQUIREMENT	MISSION REQUIREMENT		GSFC	
	INDEPENDENT	DEPENDENT	STATUS	COMMENTS
● VIDEO				
-- A/G DISPLAY/RECORD/PLAYBACK	X		E	SPIF/MSOCC
● MPS/CAP				
-- MPS	X		E	MPS/CMS AUGMENTATION PLANNED
-- CAP	X		E	SPIF
● SPACELAB/PAYLOAD SIMULATOR INTERFACE		X	N	

KEY
E - EXISTING GSFC CAPABILITY
A - AUGMENTATION OF EXISTING CAPABILITY
N - NEW REQUIREMENT

COMMUNICATIONS AND INTERFACES
EXISTING APOC NETWORK/COMMUNICATIONS VIA SPIF
[APOC - JSC MCC INTERFACE]

ITEM	To MCC	From MCC
WIDE BAND DATA		
- PAYLOAD TELEMETRY		E
- PAYLOAD COMMANDS	E	
- ORBITER ANCILLARY		E
- JSC STATUS		E
- COMMAND ACCEPTANCE PATTERNS		E
- COMMAND HISTORY		E
- ORBITER EMPHEMERIS		E
-- TRAJECTORY		
-- TRACKING DATA		E
(PLANNED MANEUVERS)		
-- ORBITER ATTITUDE		
(REALTIME AND PROJECTED)		
- CREW ACTIVITY PLANS		P
VOICE	E	E
VIDEO		E
DATA FACSIMILE	E	E
TELETYPE	E	E
TAGS	P	P

KEY

E - EXISTS OR OPERATIONAL LATE 1983 UNDER SPIF DEVELOPMENT
P - PLANNED CAPABILITY UNDER SPIF DEVELOPMENT

COMMUNICATIONS AND INTERFACES
SLDPF TO MSOCC DATA CIRCUITS

- **FIXED LOW RATE CIRCUITS:**
  - -- REQUIRES LINE DRIVERS (DIGITAL AMPLIFIERS)
  - -- SIMPLEX CIRCUITS
  - -- <$1000 EACH LINE DRIVER
  - -- 3 CIRCUITS (ECIO, SCIO, TIME)

- **VARIABLE LOW TO MED RATE CIRCUITS:**
  - -- SIMPLEX CIRCUITS FOR 3 ASTRO EXPERIMENTS
  - -- LINE DRIVERS FOR ASTRO
  - -- COAX CABLES (MOD TO INTER-BUILDING DATA TRANSMISSION SYSTEM [IBDTS] CRYSTALS) FOR 2 MBPS CIRCUITS
  - -- IBDTS COMPATIBLE FOR 500 KBPS CIRCUITS
  - -- RECEIVER DRIVERS FOR 5 & 2 MBPS CIRCUITS (6)

- **HIGH RATE CIRCUITS:**
  - -- FIBER OPTIC CARRIER
  - -- PORTED MDM BOXES IN SLDPF AND IN BLDG. 14
  - -- SINGLE LINK HANDLES UP TO 150 MBPS MIXED DATA

- **TOTAL COST:**
  - -- $500K
  - -- INCLUDES ALL CIRCUITS, BOXES, INSTALLATION, AND CABLES
  - -- INCLUDES GROWTH POTENTIAL

COMMUNICATIONS AND INTERFACES
APOC REMOTE USER REQUIREMENTS

INTERFACE	MISSION REQUIREMENT		GSFC	
	INDEPENDENT	DEPENDENT	STATUS	COMMENTS
● HRM EXPERIMENT CHANNEL RELAY		X	A	
● ECIO/SUBSETS RELAY		X	A	
● VOICE/VIDEO RELAY		X	E	
● REMOTE INVESTIGATOR FACILITY OVERVIEW/DATA PRODUCT RELAY		X	A	

KEY

E - EXISTING GSFC CAPABILITY
A - AUGMENTATION OF EXISTING CAPABILITY
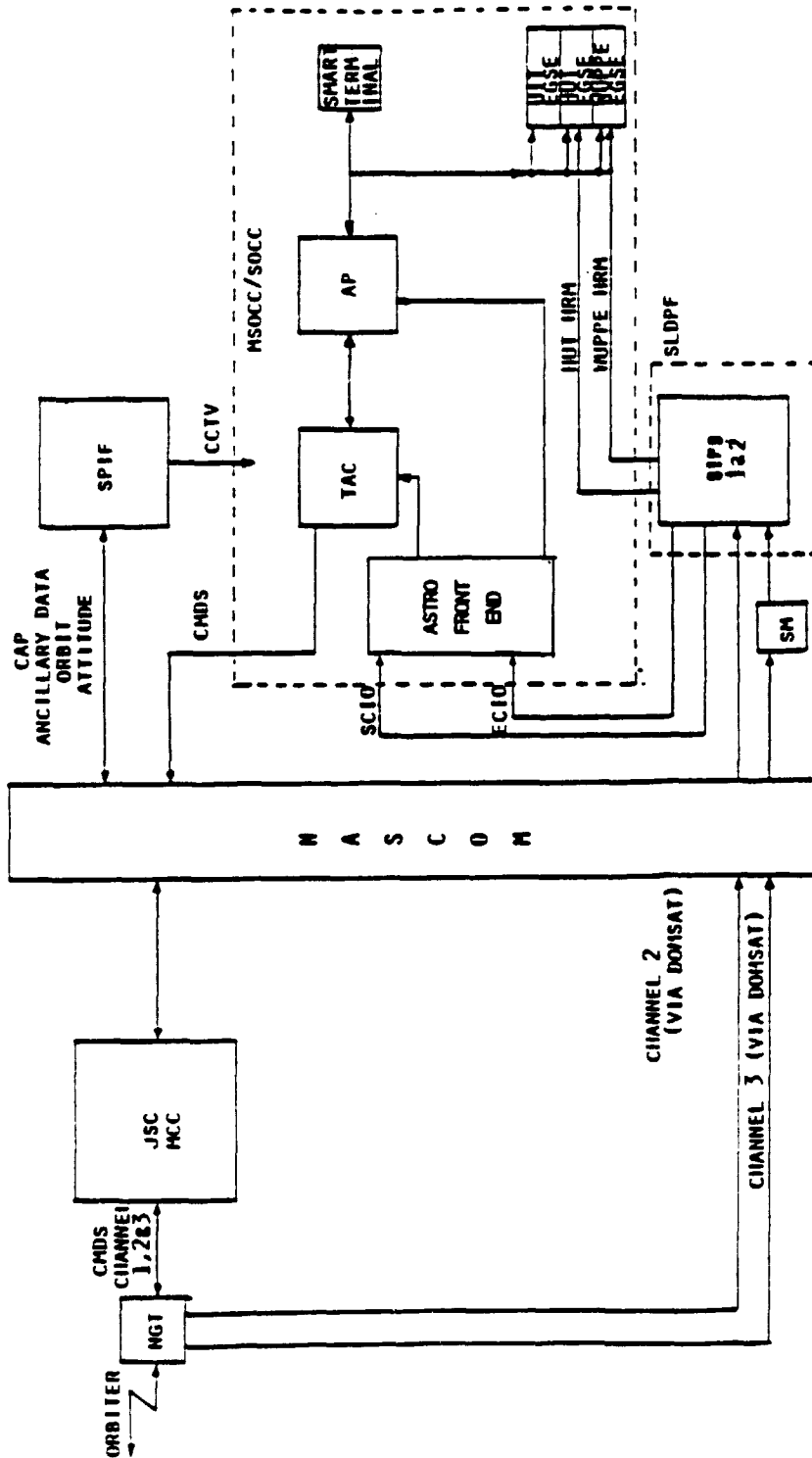
APOC CONFIGURATION (ASTRO)

Diagram labels: ORBITER — NGT — JSC MCC — NASCOM — SPIF — AP — TAC — ASTRO FRONT END — SIPS 122 — SM — SMART TERMINAL — EGSE EGSE EGSE EGSE

MSOCC/SOCC — SLDPF — CAP ANCILLARY DATA ORBIT ATTITUDE — CCTV — CMDS — SCIO — ECIO — HUT URM — WUPPE URM — CHANNEL 2 (VIA DOMSAT) — CHANNEL 3 (VIA DOMSAT) — CMDS CHANNEL 1,2&3

ACRONYMS:

AP   - Applications Processor
APOC   - Attached Payload Operations Center
CAP   - Command Acceptance Pattern
CCTV   - Closed Circuit Television
ECIO   - Experiment Computer Input Output
EGSE   - Electrical Ground Support Equipment
HUT   - Hopkins Ultraviolet Telescope
JSC   - Johnson Space Center
MCC   - Mission Control Center
MSOCC   - Multi-Satellite Operations Control Center
NASCOM - NASA Communications Network

NGT   - NASA Ground Terminal
PDI   - Payload Data Interleaver
PPF   - Payload Parameter Frame
SCIO   - Subsystem Computer Input Output
SIPS   - Spacelab Input Processor System
SM   - Statistical Multiplexor
SOCC   - Science Operations Control Center
SPIF   - Shuttle/POCC Interface Facility
TAC   - Telemetry and Command
UIT   - Ultraviolet Imaging Telescope
WUPPE   - Wisconsin Ultraviolet Photopolarimeter Experiment

APOC CONFIGURATION (ASTRO)
SPECIAL ASTRO-1 SUPPORT REQUIREMENTS

- ADDITIONAL REQUIREMENT FOR 0.3 CIVIL SERVICE MAN YEARS AND 429K$ [FY83] OVER AND ABOVE RECURRING PER MISSION COST [BREAKDOWN INCLUDED IN COST AND MANPOWER SECTION]

- CONFIGURATION REQUIRES BUILDING 3 BLOCKERS (1 SPARE) FOR THE ECIO AND SCIO DATA STREAMS. FRAME SYNCHRONIZATION IS PERFORMED IN THE TAC

- BLOCKERS APPEND A 144 6-BIT PSEUDO-NASCOM HEADER AND ADD A CORRECT POLY TO THE TRAILER FOR EVERY 4624 BITS

- ALL COMMUNICATIONS CABLING TO EGSE IS HARDWIRED DIRECTLY

- A SUBSET OF FINAL APOC SOFTWARE IS USED TO SUPPORT ASTRO-1

- SPECIALIZED SOFTWARE WILL BE DESIGNED & DEVELOPED TO PERFORM UIT ECIO DATA STRIPPING. THIS SOFTWARE DEVELOPMENT IS INCLUDED IN THE COST BREAKDOWN

APOC CONFIGURATION (SPACELAB)

- PROVIDES DATA DISTRIBUTION & SUBSET EXTRACTION

- 4 DATA STREAMS, SELECTED FROM EXPT CHANNELS, EC1O AND/OR SCIO STREAMS/ SUBSETS
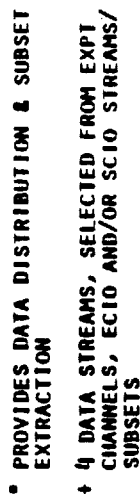
ACRONYMS

AP	- APPLICATIONS PROCESSOR	NASCOM	- NASA COMMUNICATIONS NETWORK
APOC	- ATTACHED PAYLOAD OPERATIONS CENTER	NGT	- NASA GROUND TERMINAL
CAP	- COMMAND ACCEPTANCE PATTERN	SCIO	- SUBSYSTEM COMPUTER INPUT OUTPUT
CCTV	- CLOSED CIRCUIT TELEVISION	SIPS	- SPACELAB INPUT PROCESSING SYSTEM
EC1O	- EXPERIMENT COMPUTER INPUT OUTPUT	SM	- STATISTICAL MULTIPLEXOR
EGSE	- ELECTRICAL GROUND SUPPORT EQUIPMENT	SOCC	- SCIENCE OPERATIONS CONTROL CENTER
HRDM	- HIGH RATE DEMULTIPLEXOR	SPIF	- SHUTTLE/POCC INTERFACE FACILITY
JSC	- JOHNSON SPACE CENTER	TAC	- TELEMETRY AND COMMAND
MCC	- MISSION CONTROL CENTER		
MSOCC	- MULTI-SATELLITE OPERATIONS CONTROL CENTER		

MANIFEST SATISFACTION AND POCC UTILIZATION
APOC SYSTEMS UTILIZATION

TYPE	MSFC PARTIAL	OTHER PARTIAL	FULL SPACELAB
UTILIZATION TIMEFRAME*			
Training Initiation Parameter Y (Months)	2	6	12
System Configuration Initiation Parameter X (Months)	1	1.5	2
L-Y TO L-X			
Mission Manager Data Base/ Software Verification			
- Per Mission (Hrs)	20	45-135	100-300
- Per Month (Hrs)	20	10-30	10-30
APOC Team Training and Simulations			
- Per Mission (Hrs)	20	45-135	100-300
- Per Month (Hrs)	20	10-30	10-30
L-X TO L			
Configuration/Interface Verification			
- Per Mission (Hrs)	20	40	75
Integrated Simulations			
- Per Mission (Hrs)	20	60	150
- Per Month (Hrs)	20	40	75
Operations (One Week)			
Systems Operation (Averaged) (Hrs)	40	84	168

* Early APOC team training supported within available and/or simulated capability.

MANIFEST SATISFACTION AND POCC UTILIZATION

APOC LOADING

Parameter \ FY	1984	1985	1986	1987	1988
Traffic Model (Missions)					
Full Spacelab					
Other Partials					
MSFC Partials					
Number of facilities required for manifest support (on average)					
Loading of APOC at GSFC (%)					

APOC Loading

Free Flyer Commitments

MANIFEST SATISFACTION AND POCC UTILIZATION
POCC UTILIZATION FOR PAYLOAD SUPPORT

PARAMETER FY	1984	1985	1986	1987	1988
JSC - MISSIONS SUPPORTED					
Full Spacelab	1	3	1-3	1-2	
Other Partial	2	2	1-4	1-5	
MSFC Partial	3	1	1-3	0-3	
JSC - Total	6	6	3-10	2-10	
APOC - MISSIONS SUPPORTED					
Full Spacelab			1-3	3-4	5
Other Partial			0-3	1-5	7
MSFC Partial			0-2	2-5	6
APOC - Total			1-8	6-14	18

SOFTWARE

SOFTWARE

FUNCTION	EXISTING # LINES TOTAL	EXISTING # LINES SUB-TOTAL	COMPLEXITY	CHANGES REQUIRED %	CHANGES REQUIRED # LINES SUB-TOTAL	CHANGES REQUIRED # LINES TOTAL
TELEMETRY	4500					2710
Decommutation		2000	H	75	1500	
Limit Sensing		200	L	10	20	
EU Conversion		300	L	10	30	
Special Computations		900	M	80	720	
Subset Extraction		400	M	75	300	
Bi-Level Monitoring		700	M	20	140	
COMMAND	21900					12330
Generation		11100	H	60	6660	
Uplink		1800	H	40	720	
Verification		1500	H	80	1200	
Load Processing		7500	H	50	3750	
DISPLAY	10500					1175
CRT Display		3045	M	10	300	
Printep Display		1785	L	10	180	
SCR Display		1050	H	10	100	
Event Message		3255	M	10	325	
Wild Card Generation		1365	M	20	270	

SOFTWARE

FUNCTION	EXISTING # LINES		COMPLEXITY	CHANGES REQUIRED	# LINES	
	TOTAL	SUB-TOTAL		%	SUB-TOTAL	TOTAL
MAN-MACHINE INT (STOL)	19575					4450
DIRECTIVE INPUT/USER RESPONSE		2500	M	40	1000	
SYNTACTICAL CHK		4300	M	40	1720	
DIRECTI.E AUTHORIZATION		2275	M	30	680	
D:RECTIVE CONTROLLER		1500	H	10	150	
PROCEDURE PROCESSING		9000	M	10	900	
SUPPORT (NRT)	11000					7420
INIT./CHECKPOINT		800	H	50	400	
HISTORY LOGGING		3100	M	10	310	
HISTORY DELOGGING		4600	M	10	460	
HISTORY REPLAY		2500	L	10	250	
TREND ANALYSIS		-0-	M	100	6000	
DATA BASE	60000					6700
BUILD IDB		17500	M	25	2625	
SYNTAX CHECK		10000	M	15	1500	
REPORT GENERATION		11000	M	5	550	
BUILD ODB		19000	H	10	1900	
DATA BASE COMPARE		2500	L	5	125	

SOFTWARE

FUNCTION	EXISTING # Lines Total	EXISTING # Lines Sub-Total	COMPLEXITY	CHANGES REQUIRED %	CHANGES REQUIRED # Lines Sub-Total	CHANGES REQUIRED # Lines Total
Front End Controller	11000		H	10		1100
VIP	20000					7000
Display Int		5000	H	10	500	
Display Formatting		15000	M	10	1500	
Terminal Support		-0-	M	100	5000	
SPIF STS Functions	60000		M	0		
SLDPF SIPS Input Processing	10000		H	0		
Data Operations Control (DOC)	120000		H	0		
Gateway	25000		H	0		
Simulator	15000		M	20		3000
TOTAL	393475					45885

SOFTWARE
PAST EXPERIENCE IN POCC DEVELOPMENT

[Provides Confidence in APOC Software Requirements Analysis]

Spacecraft	No. of Instruments	LOC (K)	% HOL	% Reused	LOC Reused (K)	Contractor M. Years	C.S. M. Years
ST	5	130	95	0	–	52	10.5
SMM	8	133	10	60	80	33	8.5
IUE	1	120	10	25	30	81	5
ERBS	3	120	90	80	96	16	4
DE	15	105	85	68	70	28	6.5

Key
LOC – Lines of Code
HOL – High Order Language

POCC AND POCC RELATED EXECUTABLE CODE

JSC COMPARISON (K LINES)

FUNCTION	TERMINAL	CONCENTRATOR	DAPS	DAPS C/O	POCC-370	POCC-370 C/O	CRP	NRT	OTHER*	SUB-TOTAL
JSC	34	58	160	102	257	40	192	136		979
GSFC										
TELEMETRY			2		3					5
COMMAND					22					22
DISPLAY	11									11
MAN MACHINE INT.	9				11					20
SUPPORT (NRT)								11		11
DATA BASE							50			60
FRONT END CONTROL			11							11
VIP	20									20
SPII			20		40					60
SI DP			10							10
DDL									120	120
GATEWAY									25	25
SIMULATOR				7		8				15
GSFC TOTAL	40	0	43	7	76	8	60	11	145	390

*No DIRECT COMPARISON WITH JSC POCC CODE

POCC AND POCC RELATED EXECUTABLE CODE [CONCLUDED]

JSC COMPARISON [K LINES]

FUNCTION	LOC JSC	LOC GSFC	COMMENTS
TERMINAL	34	40	
CONCENTRATOR	58	0	
DAPS	160	43	
DAPS C/O	102	7	
POCC-370	257	76	
POCC-370 C/O	40	8	
CRP	192	60	
NRT	136	11	
OTHER	-	145	
TOTAL	979	390	

HARDWARE

APOC HARDWARE
OVERVIEW

- APOC PROPOSAL DOES NOT INCLUDE UTILIZATION OF JSC HARDWARE

- EXISTING HARDWARE
  SHUTTLE/POCC INTERFACE FACILITY (SPIF)
  - 2 PDP 11/44 COMPUTER SYSTEMS
  - 8 KCRTs

  TELEMETRY AND COMMAND PROCESSORS
  - 8 PDP 11/34 COMPUTER SYSTEMS

  STRIPCHART RECORDERS (7)

- HARDWARE ON ORDER
  TEXT AND GRAPHICS SYSTEM (TAGS)
  - SCANNER AND PRINTER
  - OPERATIONAL JANUARY 1985

  APPLICATIONS PROCESSORS
  - 3 MIPS COMPUTER SYSTEMS (4)
  - DELIVERY EXPECTED FEBRUARY 1985

APOC HARDWARE
OVERVIEW (CONCLUDED)

● NEW HARDWARE

USER TERMINALS

● PERSONAL COMPUTERS (PC) WITH COLOR GRAPHICS KCRT AND DISK STORAGE
● FINAL CONFIGURATION WILL INCLUDE 40 PC SYSTEMS
● PROCUREMENT TO BE INITIATED IN JUNE 84
● DELIVERY MARCH 1985

FRONT END

● CONTAINS SWITCH, FRAME SYNCHRONIZER, PARAMETER SELECTOR AND CONTROLLING PROCESSORS
● PROCUREMENT TO BE INITIATED IN JUNE 1984
● AWARD OF CONTRACT IN MARCH 1985
● DESIGN AND FABRICATION THROUGH JUNE 1986
● INSTALLATION AND TEST THROUGH AUGUST 1986

DISKS

● 1.2 GB FOR NRT DATA ARCHIVAL
● DELIVERY JANUARY 1986

APOC HARDWARE
SPACELAB FRONT END

- REQUIREMENTS
  - -- DISTRIBUTE HRDM OUTPUT DATA TO THE AP, EGSE AND/OR REMOTE RELAY
    - 16 EXPERIMENT CHANNELS
      - ECIO
      - SCIO
    - MAXIMUM DATA RATE OF 10 MBPS PER STREAM, HIGHER RATES MISSION PECULIAR CONFIGURATION
  - -- EXTRACT A SUBSET OF DATA FROM UP TO 4 STREAMS AND DISTRIBUTE TO THE AP AND EXTRACT DATA AND/OR DISTRIBUTE TO EGSE AND REMOTE USERS.
    - 9200 PARAMETERS/SEC EXTRACTED AND PROVIDED TO NRT ON-LINE DATA BASE
    - 2000 PARAMETERS/SEC PROVIDED TO AP FOR PROCESSING WITH INCREASE TO 4000 PARAMETERS/SEC [1/86]
  - -- RESPOND TO CONFIGURATION AND FORMAT CHANGE COMMANDS IN LESS THAN 5 SECONDS
    - FORMAT CHANGE REQUIRES RECOGNITION OF DATA IDENTIFIER CHANGE
  - -- REPORT CONFIGURATION AND DATA QUALITY STATUS
  - -- EXPANDABILITY
  - -- RELIABILITY

APOC HARDWARE

SPACELAB FRONT END (CONTINUED)

● OPERATIONS

-- CONFIGURATION DATA BASE DEFINED PRIOR TO MISSION

  ● DEFINES SWITCH CONNECTIONS
    - FRAME SYNC PARAMETERS
    - PARAMETER SELECTION PARAMETERS
  ● DATA BASE RESIDES ON FRONT END CONTROLLER

-- DATA OPERATIONS CONTROL SYSTEM CONTROLS FRONT END CONFIGURATION

  ● TIMELINE AUTOMATICALLY MONITORED FOR CONFIGURATION CHANGE
  ● CHANGE APPROVED BY OPERATOR
  ● NEW CONFIGURATION ID SENT TO FRONT END
  ● FRONT END RETRIEVES PARAMETERS ASSOCIATED WITH CONFIGURATION ID FROM DATA BASE
  ● SWITCH CHANGES IMPLEMENTED IMMEDIATELY
  ● FRAME SYNC OR PARAMETER SELECTOR CHANGES IMPLEMENTED IMMEDIATELY OR ON LOSS
    OF LOCK DEPENDING ON OPERATOR SELECTED OPTION
  ● STATUS REPORTED

AFOC HARDWARE
SPACELAB FRONT END (CONCLUDED)

- COST
  - -- MANPOWER
    - PROGRAM MANAGEMENT (1 MANYEAR [MY])
    - SYSTEMS ENGINEERING AND DESIGN (2 MY)
    - HARDWARE IMPLEMENTATION (2 MY)
    - SOFTWARE IMPLEMENTATION (3.5 MY)
    - TESTING (1.5 MY)
    - DOCUMENTATION (0.5 MY)
    - TRAINING (0.5 MY)

    - TOTAL MANPOWER 11 MY AT 60K PER MY

  - -- HARDWARE COSTS
    - COMMERCIAL HARDWARE (60K)
    - UNIQUE HARDWARE (555K)
    - SPARES (70K)

  - -- TOTAL COST 1345K

- ADVANTAGES COMPARED WITH SOFTWARE IMPLEMENTATION
  - INCREASED DATA STREAM HANDLING CAPABILITY
  - HIGHER DATA RATE CAPABILITY
  - EASE OF EXPANDIBILITY
  - REDUCED COMPLEXITY

APOC HARDWARE
JSC POCC EQUIPMENT TRANSFER TO GSFC SLDPF
[PHASE-OVER PLANS FOR APOC SUPPORT]

● JSC POCC CHARACTERISTICS

-- JSC HAS 5 HIGH DENSITY TAPE DRIVES (HDTDs) AND 3 HIGH RATE DEMULTIPLEXORS
   (HRDM) COMPATIBLE WITH THE SLDPF EQUIPMENT

-- JSC FRAME SYNCHRONIZERS ARE NOT COMPATIBLE

-- JSC POCC COMPUTERS WILL REMAIN AT JSC

● ASSUMPTIONS

-- JSC EQUIPMENT TO BE AVAILABLE AFTER 1986

-- THE JSC HRDMS AND HDTDs USED TO ENHANCE THE SLDPF CAPABILITIES WHEN
   ECONOMICAL AND NOT REQUIRED FOR APOC SIPS AUGMENTATION. THEY ARE NOT CRITICAL
   FOR MISSION SUCCESS

-- THE SLDPF WOULD HAVE BEEN FULLY CONFIGURED IN 1985/1986 WITH PURCHASE AND
   INSTALLATION OF 2 MORE HRDMs, 2 HDTDs, FRAME SYNC UNITS, AND SEL COMPUTERS

-- INTEGRATION OF JSC EQUIPMENT WOULD ALSO BE ON A NON-INTERFERENCE BASIS WITH
   SLDPF SUPPORT ACTIVITIES

● EQUIPMENT TO BE RELOCATED:

-- 2 TO 5 HDTDs

-- 3 HRDMs

APOC HARDWARE
JSC POCC EQUIPMENT TRANSFER TO GSFC SLDPF
[PHASE-OVER PLANS FOR APOC SUPPORT] (CONCLUDED)

● ESTIMATED COSTS FOR TRANSFER:

DISASSEMBLY @ JSC	$20K
TRANSPORTATION	50K
ASSEMBLY @ GSFC	40K
REINTEGRATION @ GSFC (INCLU. CHECKOUT)	120K
ADDITIONAL INTERFACE H/W (SWITCHING NETWORK,	250K
IMPEDANCE MATCHING CIRCUITS, CABLES, ETC.)	
MISCELLANEOUS	20K
TOTAL	$500K

● ESTIMATED VALUE OF RELOCATED EQUIPMENT $1.5M

SCHEDULE

SCHEDULE

5 YEAR

MILESTONE SCHEDULE

LEVEL

CENTER

RESPONSIBILITY:

APPROVAL

ACCOMPLISHMENT:

ORIGINAL SCHEDULE APPROVAL _____ (Date)

LAST SCHEDULE CHANGE

STATUS AS OF _____ (Date) (No) (Initials)

(Initials)

PROJECT   ATTACHED PAYLOAD OPERATIONS
CENTER (APOC, IMPLEMENTATION

CY 1983   CY 1984   CY 1985   CY 1986   CY 1987

	MILESTONES
1	SYSTEM REQUIREMENTS ANALYSIS
2	SYSTEM REQUIREMENTS REVIEW
3	SYSTEM DESIGN
4	SYSTEM DESIGN REVIEW
5	
6	...ARE
7	ASTRO FRONT END
8	SPACELAB FRONT END PROCUREMENT
9	DESIGN & FABRICATION
10	FINAL DELIVERY
11	
12	TERMINALS PROCUREMENT
13	DELIVERY
14	
15	DISKS PROCUREMENT
16	DELIVERY
17	
18	FACILITY MODIFICATION
19	
20	

NOTES

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MILESTONE SCHEDULE

(LEVEL)

PROJECT ATTACHED PAYLOAD OPERATIONS
CENTER (APOC) IMPLEMENTATION

CENTER
RESPONSIBILITY
APPROVAL

ORIGINAL SCHEDULE APPROVAL _____ (Date)
LAST SCHEDULE CHANGE _____
_____ (Date) (No) (Initials)
STATUS AS OF _____ (Date) (Initials)

ACCOMPLISHMENT

	MILESTONES	CY 19 83	CY 1984	CY 19 85	CY 1986	CY 19 87
1	SOFTWARE					
2	AP - S/W REQUIREMENTS REVIEW					
3	PRELIMINARY DESIGN REVIEW					
4	CRITICAL DESIGN REVIEW					
5	ASTRO DELIVERY					
6	FINAL DELIVERY					
7						
8	TERMINAL S/W RQMT. REVIEW					
9	DESIGN REVIEW					
10	DELIVERY					
11	INTEGRATION AND TEST					
12						
13	ASTRO INTERNAL TESTS					
14	ASTRO EXTERNAL TESTS					
15	ASTRO SIMS					
16						
17	FINAL INTERNAL TESTS					
18	FINAL EXTERNAL TESTS					
19	FINAL SIMULATION					
20						

NOTES

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COST AND MANPOWER

NON-RECURRING [DEVELOPMENT]
CIVIL SERVICE MANPOWER AND COSTS [FY 83 K$]

WBS	FY 84 C.S. M.YRS	FY 84 TRAV COST	FY 84 CTR M.YRS	FY 84 H/W COST	FY 85 C.S. M.YRS	FY 85 TRAV COST	FY 85 CTR M.YRS	FY 85 H/W COST	FY 86 C.S. M.YRS	FY 86 TRAV COST	FY 86 CTR M.YRS	FY 87 C.S. M.YRS	FY 87 CTR M.YRS	SUB-TOTAL M.YRS C.S	SUB-TOTAL M.YRS CTR	SUB-TOTAL FY83 K$
DEVELOPMENT																
A.1.A. MGT	1	18			1	12			1	6		0.3		3.3		36
A.1.B. SYS. ENG. & DES.	2.5		1.5		2.5		1		1		0.5			6	3	180
A.1.C. H/W	2			2500	2			2005	1.5		2	0.3	3	5.8	5	4505
A.1.D. S/W	1.5		4		2.5		6.7		3		5.8	1.4	3	8.4	12.5	750
A.1.E. I&T	0.5				0.5		9		2.7		11	1.4	3.5	5.1	27	1620
A.1.F. QA/Doc	0.5		0.5		0.5		2		0.8		4.5	0.8	0.5	2.1	9	540
																300
TOTAL																
CIVIL SERVICE	7.5				9				10			4.2		30.7		
TRAVEL		18				12				6						36
CONTRACTOR			6				19.7				23.8		7		56.5	3390
H/W				2500				2005								4505

TOTAL COST	7931
CONTINGENCY 15%	1190
TOTAL COST WITH CONTINGENCY	9121

NON-RECURRING [DEVELOPMENT]
A.1.c HARDWARE ITEMS [FY83 K$]

FY	ITEM	COST	SUB-TOTAL
84	SLDPF (SIPS #4)	2500	2500
85	UPS	300	
	SPACELAB FRONT END*	615	
	SPACELAB FRONT END-SPARES	70	
	SLDPF TO MSOCC DATA CIRCUITS	500	
	MSOCC TERMINAL UPGRADE (PCs)	200	
	1.2 GB DISK SYSTEM	120	
	FACILITY MODIFICATION	200	2005
TOTAL			4505

* 11 MY AT 60K PER MY INCLUDED UNDER CONTRACTOR MANPOWER LINE ITEM

NON-RECURRING [DEVELOPMENT]
CIVIL SERVICE MANPOWER

WBS		GSFC Code	FY 84	FY 85	FY 86	FY 87	Sub-Total
A.1.A.	Management	501	1	1	1	0.3	3.3
A.1.B.	Sys. Eng. & Des	502	0.3	0.3			0.6
		511	1	1.2	0.5		2.7
		560	1.2	1	0.5		2.7
A.1.C.	H/W Design, Dev. & Mod.	511	1	1	0.7	0.1	2.8
		560	1	1	0.8	0.2	3.0
A.1.D.	Software Design, Dev. & Mod.	511	0.5	0.7	1.3	0.5	3.0
		514		0.3	0.7	0.6	1.6
		560	0.5	1	1	0.3	2.8
		580	0.5	0.5			1.0
A.1.E.	Sys. I&T	511			1.2	0.6	1.8
		513			0.5	0.2	1.7
		560	0.5	0.5	0.8	0.5	1.3
		502			0.2	0.1	0.3
A.1.F.	QA/Documentation	514		0.5	0.8	0.8	2.1
Total Development			7.5	9	10	4.2	30.7

NON-RECURRING AND RECURRING
CIVIL SERVICE MANPOWER
SUMMARY BY GSFC CODE

GSFC CODE	DEVELOPMENT					SUSTAINING	PER MISSION
	FY 84	FY 85	FY 86	FY 87	SUB-TOTAL		
501	1	1	1	0.3	3.3		
502	0.3	0.3	0.2	0.1	0.9	0.5	
511	2.5	2.9	3.7	1.2	10.3	1	0.6
513	0.5	0.5	0.5	0.2	1.7	1	1.3
514		0.8	1.5	1.4	3.7		
560	2.7	3	3.1	1	9.8	1	
580	0.5	0.5			1.0		
TOTAL	7.5	9	10	4.2	30.7	3.5	1.9

NON-RECURRING [ADDITIONAL DEVELOPMENT COST FOR ASTRO-1 SUPPORT]
CIVIL SERVICE MANPOWER AND COSTS [FY83 K$]

WBS	FY84 CTR M.YRS	FY85 CTR M.YRS	FY85 H/W COST	FY86 C.S. M.YRS	FY86 CTR M.YRS	SUB-TOTAL C.S. M.YRS	SUB-TOTAL CTR M.YRS	SUB-TOTAL FY83 K$
DEVELOPMENT								
A.1.A. MGT.								
A.1.B. SYS. ENG. & DES.	0.2	0.5					0.7	42
A.1.C. H/W		2	25		0.7		2.7	162 / 25
A.1.D. S/W	0.1	0.7			0.4		1.2	72
A.1.E I&T				0.3		0.3		
A.1.F. QA/DOC		0.5			0.7		1.2	72
TOTAL	—	—	—	—	—	—	—	—
CIVIL SERVICE				0.3		0.3		
CONTRACTOR	0.3	3.7			1.8		5.8	348
HARDWARE			25					25
TOTAL COST								373
CONTINGENCY 15%								56
TOTAL COST WITH CONTINGENCY								429

RECURRING [SUSTAINING BASE]
CIVIL SERVICE MANPOWER AND COSTS [FY83 K$]

WBS	C.S. M.Yrs	Contractor M.Yrs	Hardware Cost	Sub-total Cost FY83 K$
B.1.a. Mgt.	2			12
B.1.b. Eng & C.M.	0.5	0.2		120
B.1.c. H/W		2	320	320
B.1.d. S/W		2		120
B.1.e. QA		3		180
B.1.f. Ops Support	1	0.8		48
B.1.h. Comm. Links		9	229	540
				229
	———	———	———	———
TOTAL				
Civil Service	3.5			
Contractor		17		1020
Hardware			549	549
				———
Total Cost				1569

RECURRING [SUSTAINING BASE]

B.1.c H/W AND B.1.H COMM. LINKS ITEMS [FY83 K$]

WBS	ITEM	COST	SUB-TOTAL
B.1.C	SLDPF (SIPS #4) - SPARES	180	
	SPACELAB FRONT END - SPARES	70	
	APPLICATIONS PROCESSORS - SPARES	50	
	MSOCC TERMINAL UPGRADE (PCs) - SPARES	20	320
B.1.H	COMM. LINKS		
	- CIRCUITS TO JSC (10)	144	
	- CIRCUITS TO KSC (5)	66	
	- CIRCUITS TO MSFC (2)	19	229

RECURRING [PER MISSION-FULL SPACELAB]
CIVIL SERVICE MANPOWER AND COSTS [FY83 K$]

WBS	C.S. M.Yrs	Travel Cost	Contractor M.Yrs	Hardware Cost	Sub-total Cost FY83 K$
B.2.A. MGT.	2.5	35			35
B.2.B. Eng & C.M.			1		60
B.2.C. H/W			0.7	10	42
					10
B.2.D. S/W			2		120
B.2.E. QA			0.1		6
B.2.F. Ops. Support	1.5		7.3		438
B.2.G. Comm. Links					
B.2.H. Other Factors					
	—	—	—	—	—
Total Civil Service	4				35
Travel		35			
Contractor			11.1		666
H/W				10	10
Total Cost					711
Contingency 15%					107
Total Cost with Contingency					818

RECURRING [PER MISSION-OTHER PARTIAL]
CIVIL SERVICE MANPOWER AND COSTS [FY83 K$]

WBS	C.S. M.YRS	TRAVEL COST	CONTRACTOR M.YRS	HARDWARE COST	SUB-TOTAL COST FY83 K$
B.2.A. MGT.	1	14			14
B.2.B. ENG & C.M.			0.5		30
B.2.C. H/W			0.3		18
				3	3
B.2.D. S/W			0.8		48
B.2.E. QA					
B.2.F. Ops. Support	0.5		4.3		258
B.2.G. Comm. Links					
B.2.H. Other Factors					
TOTAL CIVIL SERVICE	1.5				
TRAVEL		14			14
CONTRACTOR			5.9		354
H/W				3	3
TOTAL COST					371
CONTINGENCY 15%					56
TOTAL COST WITH CONTINGENCY					427

RECURRING [PER MISSION-MSFC PARTIAL]
CIVIL SERVICE MANPOWER AND COSTS [FY83 K$]

WBS		C.S. M.YRS	TRAVEL COST	CONTRACTOR M.YRS	HARDWARE COST	SUB-TOTAL COST FY83 K$
B.2.A.	MGT.	0.5	7			7
B.2.B.	ENG & C.M.			-		-
B.2.C.	H/W				-	-
B.2.D.	S/W			0.5		30
B.2.E.	QA					
B.2.F.	OPS. SUPPORT			1.5		90
B.2.G.	COMM. LINKS					
B.2.H.	OTHER FACTORS					
TOTAL						
CIVIL SERVICE		0.5				7
TRAVEL			7			7
CONTRACTOR				2		120
H/W					-	-
TOTAL COST						127
CONTINGENCY 15%						19
TOTAL COST WITH CONTINGENCY						146

RECURRING [PER MISSION-AVERAGE*]
CIVIL SERVICE MANPOWER AND COSTS [FY83 K$]
[MISSION TYPE DISTRIBUTION UTILIZED FOR PREPARATION OF FOLLOWING BREAKDOWN]

MISSION TYPE	NUMBER OF MISSIONS		
	FY87	FY88	SUB-TOTAL
FULL SPACELAB	5	5	10
OTHER PARTIAL	6	7	13
MSFC PARTIAL	5	6	11
TOTAL	16	18	34

* UTILIZES MANIFEST/TRAFFIC MODEL MISSION TYPE DISTRIBUTION FOR FY 1987 AND 1988

RECURRING [PER MISSION-AVERAGE*]
CIVIL SERVICE MANPOWER AND COSTS [FY83 K$]

WBS	C.S. M.YRS	TRAVEL COST	CONTRACTOR M.YRS	HARDWARE COST	SUB-TOTAL COST FY83 K$
B.2.A. MGT.	1.3	18			18
B.2.B. ENG & C.M.			0.5		29
B.2.C. H/W			0.3		19
				4	4
B.2.D. S/W			1.1		63
B.2.E. QA			0.0		2
B.2.F. OPS. SUPPORT	0.6		4.3		256
B.2.G. COMM. LINKS					
B.2.H. OTHER FACTORS					
TOTAL					
CIVIL SERVICE	1.9				18
TRAVEL		18			
CONTRACTOR			6.2		370
H/W				4	4
TOTAL COST					392
CONTINGENCY 15%					59
TOTAL COST WITH CONTINGENCY					451

* FY 1987 AND 1988 MISSION TYPE DISTRIBUTION UTILIZED, NUMBERS ROUNDED TO PRECISION SHOWN

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JSC/GSFC OPERATING MANPOWER COMPARISON

FUNCTION	JSC	GSFC	DGSFC	
1) DATA AND CONFIGURATION	7	2	2	MSOCC PRESENTLY HAS TWO I/O COORDINATORS. THEY MAKE DATA BASE CHANGES. THEIR ACTIVITY IS AUGMENTED FOR APOC. ALSO THE SYSTEM IS DIFFERENT.
MAKE FLOPPY DISKS, DECOM FORMATS, ETC.				
2) ENGINEERING	5	4	-	PRESENTLY THERE ARE ONGOING SYSTEM ENGINEERING TASKS.
SKILL RETENTION				
3) PROJECT SUPPORT	12	3	2	USES REGULAR LOGISTICS SERVICES. SPIF PERSONNEL REVIEW ANNEXES.
CONFIGURATION MANAGEMENT, LOGISTICS, KEY PUNCH, QA PIP ANNEXES, ETC.				
4) MANAGEMENT AND SUPPORT	7	5	1	THERE ARE DAY AND SHIFT SCHEDULERS. AUGMENTED FOR MISSION SUPPORT, DOCUMENTATION TASKED OFF-SITE.
SCHEDULING, TECH. PUBS., ETC.				
5) EQUIPMENT M & O	35	10	2	THERE ARE TWO RESIDENT MAINTENANCE PERSONNEL IN MSOCC. ALL OTHER MAINTENANCE IS DRAWN FROM A MAINTENANCE POOL. 34 PEOPLE COVER ALL 6 POCCS IN EXISTENCE. 8 ARE PRORATED TO MSOCC.
BASED ON RACK COUNT AND HISTORICAL MAINTENANCE DATA.				

JSC/GSFC OPERATING MANPOWER COMPARISON (CONCLUDED)

FUNCTION	JSC	GSFC	DGSFC	
6) PROGRAMMERS	34	8	2	THERE ARE 35 PROGRAMMERS IN THE PML - 10 OF THESE ARE ALLOCATED TO MAINTENANCE AND MANAGEMENT.
SOFTWARE MAINTENANCE AND SKILL RETENTION				
7) MISSION AND SIMULATION SUPPORT	27	-	-	
COMPUTER SUPPORT		8	4	- TWO COMPUTER OPERATORS X 4 SHIFTS
DATA MANAGEMENT		4	4	- ONE DOC X 4 SHIFTS
DACON		1	4	- SLDPF CONFIGURATION
POCC PLG		3		- SPIF SUPPORT
	127	48	21	

RESOURCES REQUIRED BY MISSION & BY YEAR
[NON-RECURRING]

MISSIONS/YEAR	RESOURCES/MISSION		RESOURCES/YEAR	
	FY 83 K$	C.S. M.YRS	FY 83 K$	C.S. M.YRS
0	-	-	1569	3.5
1	2020	5.4	2020	5.4
2	1236	3.7	2471	7.3
3	974	3.1	2922	9.2
4	843	2.8	3373	11.1
5	765	2.6	3824	13
.				
10	608	2.3	6079	22.5
.				
15	556	2.1	8334	32
.				
20	529	2.1	10589	41.5